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DEAFNESS, TINNITUS, VERTIGO AND NEURALGIA

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PHILADELPHIA

THE PURPOSE of this work is to show some conditions [1] that may directly affect the eustachian tube and otherwise contribute to the production of auditory symptoms, including progressive deafness, tinnitus aurium, aural vertigo and otalgia. These symptoms may have the same cause.[2] The Committee on the Problems of the Hard of Hearing of the American Medical Association stated in their report [2] that "the most important etiologic factors in deafness are those conditions that directly affect the eustachian tube." Among the many other etiologic factors named are infection, toxicity, metabolic deficiency, endocrine disturbances, heredity, circulatory stagnation, vasomotor disturbances and chronic irritation. Hughson and Thompson [3] found, utilizing the Wever-Bray method of experimentation, that changes of pressure in the middle ear reduced auditory acuity; also, that chronic contraction of the tensor tympani and stapedius muscles reduced aural conduction. Their findings showed that injury to any part of the ear renders the ear incapable of functional fatigue and thereby causes degeneration of the organ of Corti. Lurie,[4] also using the Wever-Bray experiments, found that chronic contraction of the tensor tympani reflex resulted in degeneration of the organ of Corti.

These etiologic explanations of auditory symptoms indicate that there are many etiologic factors. Those which I present herewith probably influence about 40 per cent of all deafness. They particularly fit into the picture of progressive deafness, tinnitus and vertigo of adults. Ten million Americans suffer with impaired hearing, according to Fowler.[5] Seventy per cent of all deafness is of the progressive adult type, which

From the Edward C. Kirk Dental Research of the University of Pennsylvania.

1. Goodfriend, D. J.: J. Am. Dent. A. **21**:204 (Feb.) 1934.

2. Hays, H.; Newhart, H.; Pierce, N.; Phillips, W., and Shambaugh, G. E.: Report of Committee on Problems of the Hard of Hearing, Section on Laryngology, Otology and Rhinology of the American Medical Association, J. A. M. A. **83**:2094 (Dec. 27) 1924.

3. Hughson, W., and Thompson, E.: Research in Audition: Next Steps, Experimental Findings and Their Clinical Aspects, Arch. Otolaryng. **29**:903 (June) 1939.

4. Lurie, M. H.: Laryngoscope **47**:418 (June) 1937.

5. Fowler, E. P.: Tr. Am. Laryng., Rhin. & Otol. Soc. **38**:1, 1932.

cannot be prevented or successfully treated in the present state of medical knowledge, according to Shambaugh and associates.[6]

The studies on which this report is based were carried out in the department of dentistry, medicine and psychology of the University of Pennsylvania. Originally inspired and guided by Dr. Edward C. Kirk in 1925, they were prosecuted in cooperation with, and through the courtesy of, Dean Charles R. Turner in dentistry, Professors George Fetterolf and George M. Coates in otolaryngology, Prof. Eliot R. Clark in anatomy, Professors Henry H. Pancoast, Eugene P. Pendergrass and Karl Kornblum in radiology and Prof. Edwin B. Twitmyer in psychology.

The work in dentistry included studies of a group of 168 dental students. Their dental articulations were typed and correlated with audiometric findings made by a technician at the University Hospital. These showed that 55 per cent of the dental students examined had dental malocclusions. The hearing of this group was 13 per cent less than that of the students with normal dental articulations.

The work in the dental department also included standardization of diagnostic procedures, development of a technic for the correction of abnormalities of dental bite and mandibular joint, and the treatment of patients referred from the otologic and speech clinics. These findings have been reported in the dental literature[7] and will be published in the speech field.

The work in otolaryngology included the conduct of a special clinic to which were referred the patients with negative objective evidence of aural disease from the otologic clinic of the University Hospital. These had received a complete otologic diagnosis, audiometric tests and, in most cases, Bárány tests. Dental diagnosis included roentgenographic studies of their mandibular joints in the department of radiology of the University Hospital. Twenty-three of the first 25 with negative objective evidence of disease of the ear examined had abnormalities of dental bite and mandibular joint. Their symptoms included progressive deafness, tinnitus and vertigo. The Bárány findings usually included labyrinthitis. Certain patients were selected for correction of dental and temporomandibular abnormalities. The disease of 2 of the patients treated had been diagnosed as Ménière's disease. The cause of the symptoms of one of these had been diagnosed by the neuro-otologist as a vascular tumor of the base of the brain. Both responded favorably to treatment that was exclusively dental. They have been observed since. The progress of the deafness was at first reversed but later con-

6. Shambaugh, G. E.; Wallner, L. J.; Greene, L. D., and Shambaugh, G. E., Jr.: Severe Deafness in Adults: Clinical Study, Arch. Otolaryng. **18**:430 (Oct.) 1933.

7. Goodfriend, D. J.: Dent. Cosmos **74**:523 (June) 1932.

tinued at what the patients thought was a slower rate than that noted previous to the dental treatment. The acute vertigo disappeared, but the patients say that they feel a slight "wuzziness" at times. The tinnitus was altered and made more bearable to the patients, who have not since sought further otologic treatment. These cases of dental treatment for aural symptoms have been reported,[8] and are brought up to date in this report.

The work in radiology included the development of a technic for studying the mandibular joint. The technical procedures were worked out by Pendergrass and Kornblum. I standardized normality and typed some abnormalities. These findings have established certain scientific criteria in dentistry. They were presented to the Eastern Radiological Conference in 1933 and partially reported in a dental periodical.[9]

The work in psychology was done in the speech clinic of that department. Patients from this source who were studied and treated were children with speech defects associated with traumatic movements of the mandible. They also had auditory disturbances. The traumatic movements of the jaws were caused by malarticulations of the teeth and the mandibular joints. The auditory disturbances included reduction of acuity and disturbance of hearing kinesthesia. These symptoms responded to dental treatment more favorably than those of the older patients of the otologic clinic. In many cases their auditory functions became and remained functionally normal. The speech defects were corrected with and without speech training. This work was presented to the American Association of Applied Psychology in 1940.

The work in anatomy consisted of dissections of the heads of cadavers with normal dentitions and with varying types of abnormalities of dental bite. These dissections were first directed toward standardizing the anatomy of the normal masticating mechanism and the relationship of the normal mandibular joint to the ear and the eustachian tube. Studies were then made of the anatomy of mandibular joints of cadavers with various types of abnormalities of dental bite and of the relationship of these to the ears and the eustachian tubes. For histology, I have relied on the published works of Redfern,[10] Axhausen,[11] Steinhardt [12] and others.

These studies show that there is an intimate anatomic relationship between the temporomandibular joint, the auditory meatus, the tympanic membrane, the tympanic cavity and the eustachian tube. They also

8. Goodfriend, D. J.: Dent. Cosmos **78**:1292 (Dec.) 1936.

9. Goodfriend, D. J.: Dent. Cosmos **75**:844 (Sept.); 947 (Oct.); 1106 (Nov.) 1933.

10. Redfern, P.: Monthly J. M. Sc. **9**:967, 1065, 1112 and 1275, 1849; **10**:214, 1850.

11. Axhausen, G.: Deutsche Ztschr. f. Chir. **232**:238, 1931.

12. Steinhardt: Deutsche Ztschr. f. Chir. **241**:531, 1933.

show that the nerve and blood supply and drainage of these parts of the ear pass between the mandibular joint and the ear. They show that this relationship is altered by abnormal dental bites which, in turn, alter the structure, relationships and movements of the temporomandibular joints. This causes injury, irritation, deformity and degenerations of the auditory meatus, the tympanic membrane, the wall of the tympanic cavity, the eustachian tube and the nerves and blood vessels that supply them. Thus abnormalities of dental bite may be important factors in the production of certain auditory disturbances and neuralgias.

This intimate interrelationship has been recognized for many years by anatomists and physicians. Zuckerkandl observed that the tympanic plate was perforated by the condyle of the jaw in many adult skulls. Politzer [13] called this to the attention of otologists as early as 1880. Monson [14] in 1919 and W. H. Wright [15] in 1920 presented this hypothesis to dentistry with a case history and scientific proof of its validity. During the past twenty-five years many workers in dentistry and otology have presented further proofs. These include Kirk,[16] Maves,[17] Smith,[18] Green,[19] Pippen [20] and many others in dentistry. In otology they include G. H. Wright,[21] Babbitt,[22] Seaver,[23] Costen [24] and others.

Shapiro and Truex [25] in a review of this subject included among their findings the following:

> Irritation of the auriculotemporal nerves may bring about and maintain reflex contraction of the tensor tympani muscle through motor fibers of the trigeminal nerve, which pass through the otic ganglion to supply the muscle. Anything that interferes with the normal tension existing among the tympanic membrane, the ossicles and the contents of the oval window will cause tinnitus and deafness (Ballenger's physiologic law). If the tensor tympani muscle were reflexly thrown into tonic spasm, one might expect to find symptoms similar to those produced in experimental animals by hanging 5 to 50 gm. weights on its tendon. Crowe [26]

13. Politzer, A.: A Textbook of the Diseases of the Ear and Adjacent Organs, Philadelphia, Henry C. Lea's Son, 1883, p. 11.
14. Monson, G. S.: J. Nat. Dent. A. **7**:399 (May) 1920; **8**:833 (Oct.) 1921.
15. Wright, W. H.: J. Nat. Dent. A. **7**:979 (Dec.) 1920.
16. Kirk, E. C.: Dent. Cosmos **71**:297 (March) 1929; **72**:631 (June) 1930.
17. Maves, T. W.: J. Am. Dent. A. **22**:763 (May) 1935.
18. Reference deleted by the author.
19. Green, E.: Ann. Otol., Rhin. & Laryng. **46**:150 (March) 1937.
20. Pippen, B. N.: Washington Univ. J. **6**:107 (May) 1940.
21. Wright, G. H.: Ann. Otol., Rhin. & Laryng. **34**:700 (Sept.) 1925.
22. Babbitt, J. A.: Ann. Otol., Rhin. & Laryng. **41**:21, 1932.
23. Seaver, E. P., Jr.: Ann. Otol., Rhin. & Laryng. **46**:140 (March) 1937.
24. Costen, J. B.: Neuralgias and Ear Symptoms Associated with the Disturbed Function of Temporomandibular Joint, J. A. M. A. **107**:252 (July 25) 1936; J. Am. Dent. A. **24**:1507 (Sept.) 1937.
25. Shapiro, H. H., and Truex, R. C.: J. Am. Dent. A. **30**:1147 (Aug.) 1943.
26. Crowe, S. J.: Proc. Internat. Assemb. Inter-State Post Grad. M. A. North America, 1932, p. 185.

and Crowe, Hughson and Witting,[27] in such investigations, found a marked loss of low tones, reporting that "with extreme tension on the tensor tympani muscle and the consequent fixation of the ossicular chain, transmission of all tones below 2,048 can be reduced until they are no longer audible.

. . . The chorda tympani and sensory branches of the facial nerve may possibly be responsible for loss of low tones by a seventh nerve reflex arc. Through its motor fibers, this nerve supplies the stapedius muscle, which act upon the base of the small stapes bone. Tonic spasm of this muscle tends to fix the stapes and simulates the experimental results of separating the incudostapedial joint; namely, loss of spoken words and all pure tones up to 1,024 double vibrations per second. The higher tones (with frequencies of 2,048 and 4,096) are still transmitted, though with greatly reduced intensity.

Their conclusion in part was that:

A differential diagnosis of the type of hearing impairment . . . is essential before attempting therapeutic measures. If tests indicate, in cases of a reduction in the intermaxillary vertical dimension, that deafness is of the obstructive type . . . the dentist may, in these cases, hope to attain success in relieving the condition by opening the bite.

Kelly [28] in a carefully controlled study showed the influence of the dental bite on the function of the eustachian tube. In an investigation at the submarine base at New London, Conn., he treated dentally 50 men with defects of bite who had objective symptoms of aero-otitis media following tests in the pressure chamber. This condition is caused by failure or malfunction of the eustachian tube, and its signs may be observed with the otoscope. Two control groups were not treated. Correction of the dental bite alone cured 46 of the 50 patients. Subsequent pressure tests showed no recurrence of the condition in those cases in which dental treatment was successful, while the condition remained unimproved in the control cases. Stacey Guild, cooperating with Kelly in this study, observed that patients with aero-otitis media had edema of the eustachian tube caused by stasis of the tubal lymphatics. All the treated patients had adenoids. Twenty had enormous adenoids that covered the ostia of the tubes. This group responded favorably to the dental treatment without treatment for the adenoids. This work shows conclusively that abnormalities of dental bite may cause malfunction, edema and lymphatic stasis of the eustachian tube and resultant auditory conditions.

Deafness, tinnitus, vertigo and neuralgia of the lateral facial region involve the health, happiness and usefulness of approximately 10 per cent of humanity. Any partial solution of this problem that promises a measure of alleviation or prevention merits recognition and encourage-

27. Crowe, S. J.; Hughson, W., and Witting, E. G.: Function of Tensor Tympani Muscle, Arch. Otolaryng. **14**:575 (Nov.) 1931.

28. Kelly, W. J.: Research Project X-434, Medical Research Department, United States Submarine Base, New London, Conn., Jan. 21, 1946.

ment, adoption and application. The workers in this field have validated an etiologic factor in certain aural disturbances and neuralgias as thoroughly as Koch proved that the tubercle bacillus causes tuberculosis. Koch's etiologic explanation is accepted universally, and its adoption and application have fortified medicine in the control and the prevention of that disease despite the fact that the bacillus may be present without causing the disease or that tuberculosis had not been cured by the direct killing of the tubercle bacillus.

Auditory malfunction, such as the syndrome of progressive deafness, is the result of degenerative conditions. As in pyorrhea, the cause may be an abnormal dental bite, the resultant trauma and other factors, including predisposing susceptibility. In this category it is a preventable and controllable condition. Control depends on the degree and the duration of the disease and on the susceptibility of the patient. Prevention requires early recognition and treatment of the causes.

Knowledge of the causes of the syndrome of progressive deafness is more important than the determination of its nature, because knowledge of the cause establishes a basis for prevention. Medical knowledge and recognition of the dental causes of auditory disturbances will establish dental treatment of abnormalities of the bite as the proper therapy in the prevention and the treatment of these auditory conditions. This will add to the responsibilities and opportunities of dentistry in cooperating with medicine for alleviating human suffering and contributing to public health.

NORMAL AND ABNORMAL ANATOMY AND PHYSIOLOGY OF THE AREAS OF THE MANDIBULAR JOINT AND EAR

The ear is situated above, behind and around the mandibular joint. The mandibular joint is a sliding hinge joint, loosely confined, with an interarticular meniscus between the condyle of the mandible and the mandibular fossa and articular eminence of the temporal bone. The articular relationships are dependent on the posture of the mandible which is, in turn, dependent on the articulation of the teeth. When the dental articulation is normal, the mandible is positioned so that the condyle is situated in the lower, forward portion of the fossa—in juxtaposition to the posterior slope of the articular eminence. The meniscus is thinnest at this point. Its thick posterior portion occupies the depth of the fossa and acts as a cushion to absorb the reflected shocks of the contacts of the teeth. The posterior limit of the normal fossa is the petrotympanic fissure, behind which is the tympanic plate of the temporal bone. Just lateral to this is the anterior wall of the external auditory meatus, while medially are the anterior-inferior wall of the tympanic cavity and the lateral wall of the eustachian tube. This is shown in figure 1, which is a sketch of the ventral aspect of this area. The size

of this area is approximately 1½ by ¾ inch (37 by 18 mm.); thus the size of the parts of the ear are reduced to minute proportions, and this contributes to their fragility and sensitivity, making them comparatively susceptible to degeneration and dysfunction, and incapable of regeneration.

When the mandibular joint is normal, there is present between the joint and the ear a fold of gland and connective tissue through which the nerves and the vessels pass to supply the joint and the external meatus, the tympanic membrane and the middle ear. Some of these

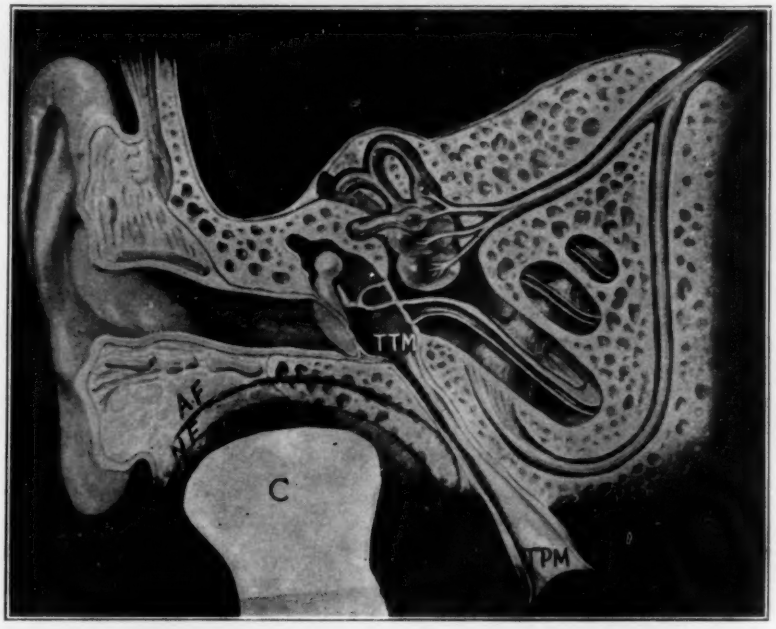

Fig. 1.—A sketch of the ventral aspect of the mandibular joint–ear area showing the intimate anatomic relationships. The mandibular condyle, *C*, is the movable part of the joint of the jaws. The normal fossa is outlined by line *NF*. Abnormal dental bites cause various and progressive malrelations of the joint with displacement of the condyle and the fossa as shown by line *AF*. These altered relationships involve the inferoanterior walls of the external auditory meatus, the attachment of the tympanic membrane, the wall of the tympanic cavity and the lateral wall of the eustachian tube. They also involve the reflexes of the tensor tympani (*TTM*) and the tensor veli palatini muscles (*TPM*).

enter the ear through the anterior wall of the meatus. Others enter the middle ear through the petrotympanic fissure, which also lodges the processus gracilis of the maleus and transmits the chorda tympani. This is shown in figures 2 and 3.

The functions of the mandibular joint include the various movements associated with mastication, speech and other movements of the

mandible. They are accomplished by the muscles of mastication. The mandible is suspended as in a hammock by the two pairs of masseter and internal pterygoid muscles. The opening of the jaws is accomplished by the contratction of the external pterygoid muscles and the relaxation of the other muscles of mastication. The movements of the mandibular joint during this jaw movement is a forward-downward movement of the condyle and the meniscus. The closing of the jaws is accomplished by the contraction of the temporal, masseter and internal pterygoid muscles and the relaxation of the external pterygoid muscles. The movement of each joint is an upward-backward return of the condyle

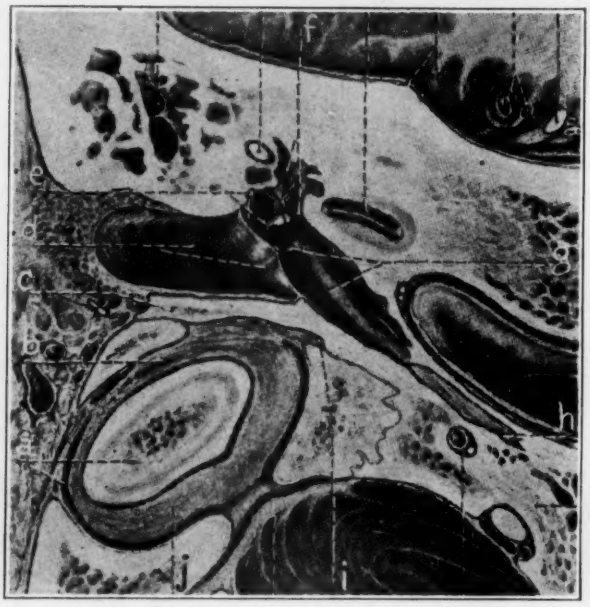

Fig. 2.—A cephalic aspect of the normal relationships of the mandibular joint to the ear as presented in a cadaver with a normal dental bite (Shapiro and Truex[25]): (*a*) condyle; (*b*) posterior part of the capsule; (*c*) tympanic plate of the temporal bone and the auriculotemporal nerve; (*d*) external auditory meatus and tympanic membrane; (*e*) ossicles of the ear; (*f*) stapes, bone and muscle; (*g*) tensor tympani muscle and drum; (*h*) eustachian tube and tensor veli palatini and tensor tympani muscles; (*i*) chorda tympani nerve; (*j*) meniscus of the mandibular joint.

and meniscus to the joint relationship noted in the preceding anatomic description. This upward-backward movement of each condyle with the closure of the jaws continues until the teeth occlude. If the teeth are malarticulated, there is a resultant malarticulation of the mandibular joint, in which the condyle and meniscus are displaced. The condyle may be in contact with the depth or back of the fossa, while the meniscus may be traumatized and displaced medially. Some abnormalities of

the bite, with the mandibular malarticulations which they cause, are shown by the dissections and histologic sections illustrated by figures 3 to 6.

Articulation of the teeth refers to the contact relationships of their biting surfaces. The stationary-rest position of contact is the most posterior position of the lower teeth, in which they are in comfortable contact with the upper teeth. This is termed "centric occlusion." It is the contact relationship of the teeth in the unconscious closure of the jaws, as with

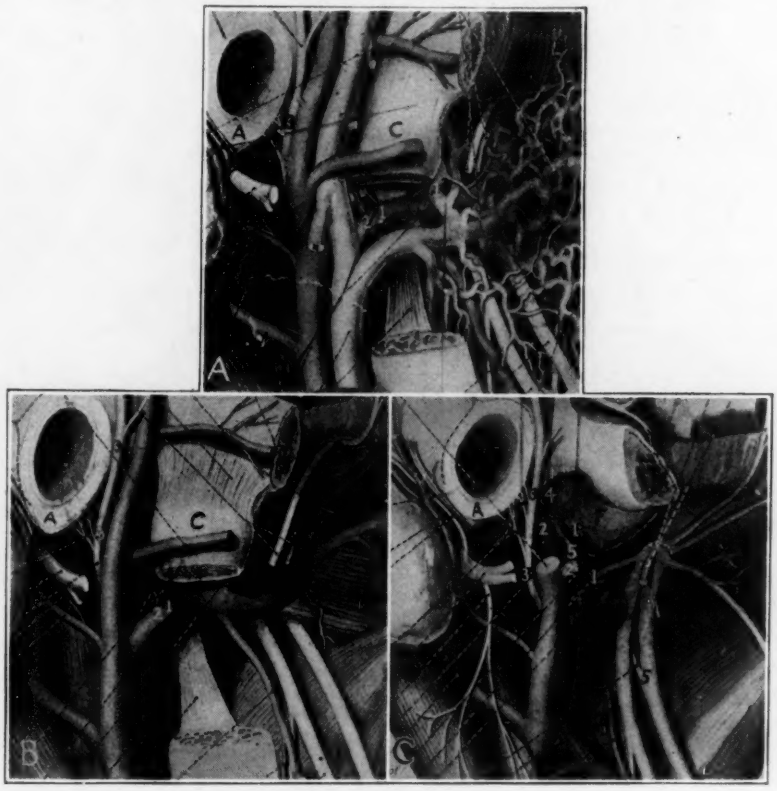

Fig. 3.—Sections showing the mandibular joint–ear area with the condyle, the capsule and the veins progressively removed to show the arteries, veins and nerves that traverse this area and supply the joint and the ear. These include: *1*, the anterior tympanic artery and vein that traverse the glaserian fissure (*4* in part *C*) in the posterior portion of the normal joint fossa, *F*; *5*, the chorda tympani, which accompanies the foregoing vessels and supplies the tongue and the submaxillary glands; *A*, the auditory meatus; *3*, the auriculotemporal nerve passing behind the joint to supply it, the membranes of the external and middle portions of the ear, and the temporal surface of the head; *2*, the deep auricular artery and vein; *C*, the condyle and capsule of the mandibular joint.

swallowing. Thus a person's centric occlusion is dependent on the posture in which the biting tooth surfaces meet, and if this is abnormal, the centric occlusion is abnormal. Since the various movements of the

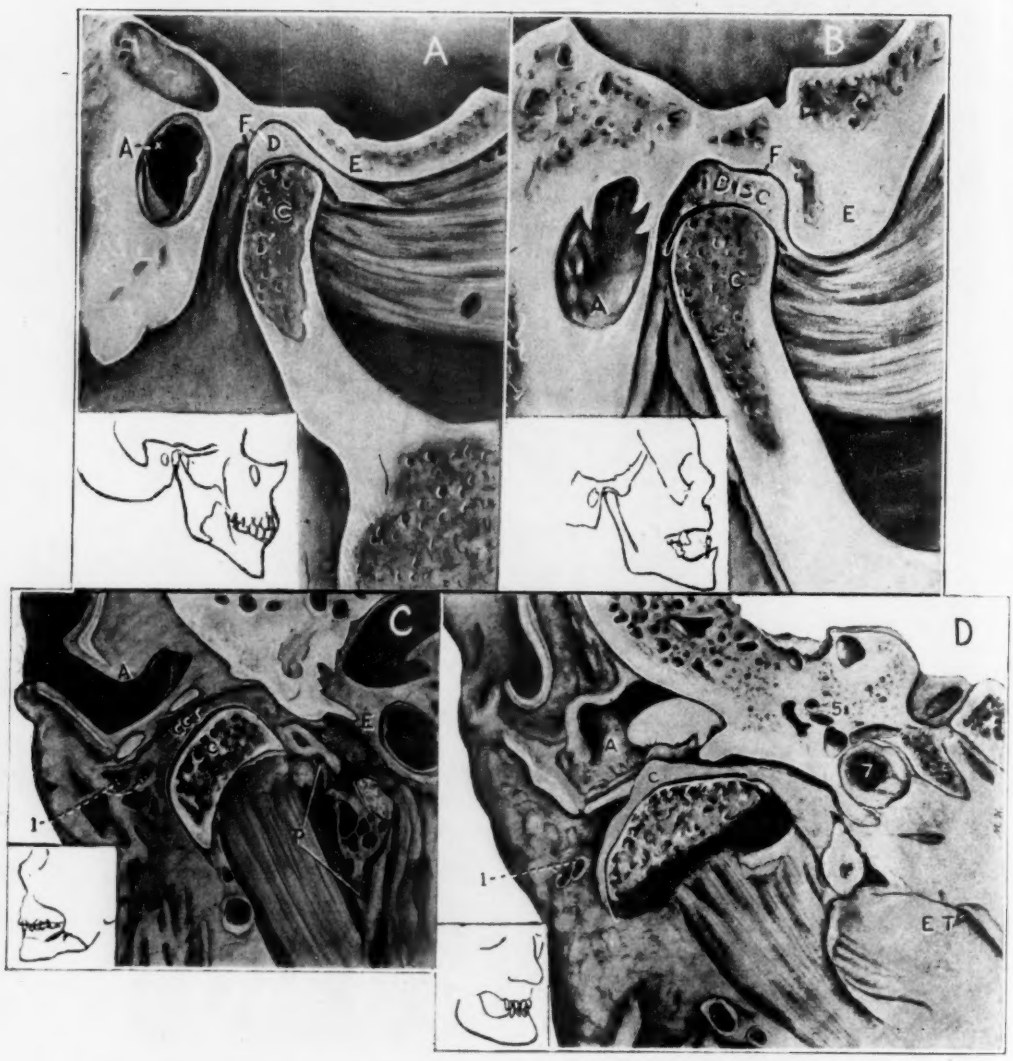

Fig. 4.—Comparison of mandibular joint–ear structures and relationships in cadavers: *A*, normal dental bite as viewed from the lateral aspect; *B*, same view with abnormal, traumatic dental bite; *C*, normal dental bite from the superior aspect; *D*, same view with abnormal, traumatic dental bite. These show the altered relationships, degeneration and deformity of the external auditory meatus and of the neurovascular tissue between it and the mandibular joint that may be caused by dental bite abnormalities.

In *A*, lateral view of a dissection of the normal mandibular joint–ear area of a cadaver with a sketch of the associated normal dental bite, *A*...*x* indicates the auditory meatus; *F*, the posterior border of the fossa of the normal joint; *E*, the articular eminence; *D*, the interarticular fibrocartilage, or meniscus; C, the mandibular condyle.

In *B*, lateral view of a dissection of the mandibular joint–ear area of a cadaver with a sketch of the associated overclosed traumatic dental bite, note the resorption

mandible start from and return to centric occlusion of the teeth, an abnormal centric occlusion causes abnormal movements of the mandible and of the mandibular joints. These include retarded, excessive and traumatic movements of the condyles and the mandible. Some of these are illustrated by the roentgenograms of the mandibular joints shown in figures 10, 11 and 12.

Mastication is accomplished by variations of the opening-closing jaw movements which move the mandible from a centric to a forward and lateral position, and then back to centric occlusion. With the food bolus between the front teeth, this movement accomplishes an upward-backward scissors contact of the incisor teeth. With the food bolus between the side and the back teeth, these movements crush the food by gliding contacts of the cusps of the bicuspid and molar teeth as they move from edge-on to the intercuspal relationships of centric occlusion. These moving contacts of mastication may be better understood if the masticating mechanism is visualized as (1) a base consisting of three contacts, at the temporal bones on each side and the upper dental arcade, and (2) a movable tripod consisting of the mandible with contacts at the two condyles and the lower dental arcade. The articulations of these three contacts are interdependent and always move together.

In the normal bite the articular arrangement of the biting surfaces of the teeth is on a curve that, if projected, would pass through the articular surfaces of the mandibular joints as illustrated by the sketch in figure 4 *A*. This arrangement of the teeth provides for their untraumatic gliding from an edge-on to an intercuspal relationship in symmetry with the movements of the condyles around the articular eminences of the temporal bones. This is termed an anatomically balanced dental articulation. It is an ideal normality, greatly to be desired, though comparatively infrequently seen in natural dentitions. It is an imperative

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EXPLANATION OF FIG. 4—CONTINUED

of the fossa and the degeneration of a condyle and of the interarticular cartilage, the reduction of space between the condyle and the auditory meatus and the traumatic joint and dental articulations. The letters have the same significance as in *A*.

In *C*, showing the superior aspect of the normal dental bite, *1* indicates blood vessels and nerves that supply the auditory meatus; *GCT*, the fold of glandular connective tissue normally present between the joint and the ear; *C*, the condyle of the mandibular joint; *A*, the auditory meatus; *E*, the eustachian tube; *P*, the pterygoid venous plexus.

In *D*, showing a transverse section of the mandibular joint–ear area of a cadaver with a sketch of the associated abnormal bite, note that the anterior wall of the meatus may be perforated by the posterior displacement of the condyle of the mandibular joint resulting from the loss of posterior teeth and the deep overbite of the anterior teeth. *A* indicates the auditory meatus; *C*, the capsule of the mandibular joint; *1*, displaced blood vessels; *5*, the inner ear; *ET*, the eustachian tube.

objective to be sought in the correction of defects of bite by occlusal reconstruction and dental replacements.

The mandibular joints are in movement most of the time, because the jaws are slightly apart in a normal relaxed position of rest. As the saliva accumulates in the mouth and is swallowed, the jaws are closed, to be opened again to the rest posture. These movements are intensified by chewing and speaking. One may study these movements by placing the little fingers in the external auditory meatuses and putting the jaws through various movements as illustrated in figure 8.

The mandibular joints evolve with the eruption of, and degenerate with the loss and attrition of, the teeth. Evolutional dental malocclusions are associated with evolutional malarticulations of the mandibular joints. Disease, attrition and loss of teeth, also unscientific restoration and replacement of teeth, are associated with alterations of the anatomic relations and functions of the mandibular joints. These may cause resorption and degeneration of the articulating bone surfaces, displacement and traumatic movements of the condyles and degeneration of the fibrocartilaginous articular surfaces and of the meniscus, as is shown by the anatomic and histologic sections and roentgenograms in figures 4 to 12. These alterations and degenerations, in turn, alter the relationships of the joint to the ear, and may cause irritation, resorption, perforation, degeneration and exostosis of the bone and connective tissue wall between the mandibular joint and the external auditory meatus, the middle ear and the eustachian tube. This wall, on its aural aspect, affords attachment for certain of the cartilages, membranes, muscles and tendons of the external auditory meatus and middle ear and forms part of the bony portion of the eustachian tube. It also transmits branches of the auriculotemporal nerve to the external and middle ear and branches of the superficial temporal artery and vein to the external ear. The petrotympanic or glaserian fissure at the normal posterior border of the mandibular joint transmits the anterior tympanic artery and vein that supply the middle ear and the chorda tympani nerve that supplies the tongue and the salivary glands. This fissure also lodges the processus gracilis of the malleus of the ossicles of the ear. The medial aspect of this wall is the lateral wall of the bony eustachian tube.

This dividing wall, illustrated in figure 2, is actually the connective tissue, glands, cartilage and bone that form these parts of the ear and the mandibular joint and that lodge and transmit their nerves, arteries, veins, membranes, ligaments and muscles. This intimate relationship of the ear to the mandibular joint shows the importance of the health and integrity of this wall, which I will show may be chronically injured, deformed, displaced and resorbed as a consequence of the abnormalities of the mandibular joint caused by overclosures of the dental bite and traumatic dental articulations.

These relationships of the ear to the temporomandibular joint and the dental bite are shown by dissections that view the ear–mandibular joint area from lateral, horizontal and sagittal points of view. My procedures in making the dissections that are illustrated herewith were as follows:

Wet specimens were selected—some with normal, adequate dental bites and some with varying types of abnormalities of the dental bite. The teeth were wired in occlusion. The heads were frozen. Sections were made through the ear-mandibular joint area in various aspects. The sections which show the eustachian tube were made by placing a wooden applicator in the tube and then directing the cut so that it bisected the mandibular condyle and the circumference of the wooden applicator. A similar section is shown as figure 1261 of Piersol's Anatomy.[29]

The normal anatomy and neurovascularity of the ear–mandibular joint area are illustrated in figure 3. These are reproductions from the Anatomy of Sobatta and McMurrick.[30] They show the close anatomic relationships of the joint and the ear and also that nerves, arteries and veins which supply the ear pass through the area of the mandibular joint.

Figure 3 *A* shows this area superficially and illustrates the neurovascularity of the half inch of tissue normally present between the condyle of the mandible and the external auditory meatus. The vessels seen are the superficial temporal artery and veins, which send branches behind the neck of the condyle to the mandibular joint, the maxillary area and the ear. Accompanying these branches in the opposite direction is the auriculotemporal branch of the trigeminal nerve that supplies the lining of the eustachian tube, the tympanic cavity, the external auditory meatus, the tympanic membrane and the lateral surface of the head.

Figure 3 *B* shows this area with part of the condyle and the ramus of the maxilla removed to reveal the internal maxillary branch of the superficial temporal artery as this gives off the deep auricular and anterior tympanic arteries to supply the external and middle portions of the ear. Also shown are the pterygoid venous plexus and the veins that drain the areas of the eustachian tube and middle ear, also branches of the auriculotemporal nerve entering the auditory meatus.

Figure 3 *C* shows this area with the mandibular condyle, the meniscus and the capsule removed to disclose the anterior tympanic and the deep auricular arteries branching from the internal maxillary artery and passing upward behind the mandibular joint. The anterior tympanic

29. Piersol, G. A.: Human Anatomy, edited by G. C. Carl, ed. 9, Philadelphia, J. B. Lippincott, 1930.

30. Sobatta, J., and McMurrick, J. P.: Atlas of Human Anatomy, New York, G. E. Stechert & Company, 1928, vol. 3.

artery is shown to enter the middle ear through the petrotympanic fissure, which also conveys an accompanying vein and the chorda tympani nerve. This fissure also lodges the processus gracilis of the malleus, and its lip is the posterior border of the normal mandibular joint fossa. The auriculotemporal nerve is shown passing laterally behind the mandibular joint. It gives off branches that supply the tympanic membrane, the lining of the external and middle ears and the eustachian tube. This area and these blood vessels and nerves are subjected to chronic irritations, displacements and physical traumas when the mandibular joint is abnormal.

A lateral view of this area is illustrated in figure 4 *A*. This is a drawing made from a section of a cadaver with normal dental articulation and shows the normal relationship of the condyle to the fossa and the ear. The condyle is separated from the fossa by the meniscus and from the auditory meatus by a fold of the parotid gland. When the posturing support of the teeth is diminished as in the specimen illustrated in figure 4 *B*, the condyle is displaced superiorly and posteriorly. This shows that loss of the posterior teeth caused deformity of the fossa, degeneration of the meniscus, chronic trauma, compression, and displacement of the parotid gland fold and the various nerves and vessels normally found in the area between the joint and the ear.

The transverse view of these parts and their relationships in cadavers with normal and in those with abnormal dental bites is illustrated in figures 4 *C* and 4 *D*. Figure 4 *C* shows a normal specimen in which the posterior surface of the condyle is separated from the auditory meatus by the parotid fold and the anterior wall of the meatus. This also shows the relationship of the vessels in this area and the elbow of the meatus around the joint. Figure 4 *D* is a similar section of the same area of a specimen in which the posterior teeth are lost and the anterior teeth are in a deep closed bite relationship. In this specimen the condyle was displaced posteriorly. It, in turn, displaced the parotid gland, the blood vessels and the nerves, and perforated the anterior wall of the auditory meatus. To comprehend fully the displacements and injuries associated with this closed dental bite, one should bear in mind that the traumatization is continuous, day and night, with speaking, eating, swallowing and other movements of the jaws. The abnormality of bite of this cadaver, as shown by the sketch, represents the type of traumatic closed bite that is most injurious to the mandibular joint and ear.

Figure 5 shows histologic studies of normal and of abnormal temporomandibular joints from Steinhardt.[12] The first row of sections in figure 5 shows the bone and cartilage formation of three types of joints associated with normal, adequate dental bites. The integrity of the bones and their cartilages and of the fibrocartilaginous meniscus of each

joint may be seen in these sections and compared with the abnormal conditions shown in the second and third rows of the same figure. The latter are sections of similar type joints of specimens with dental bites in which the teeth have been lost and abraded or are in traumatic malocclusion. These show the deformity and degeneration of the bones

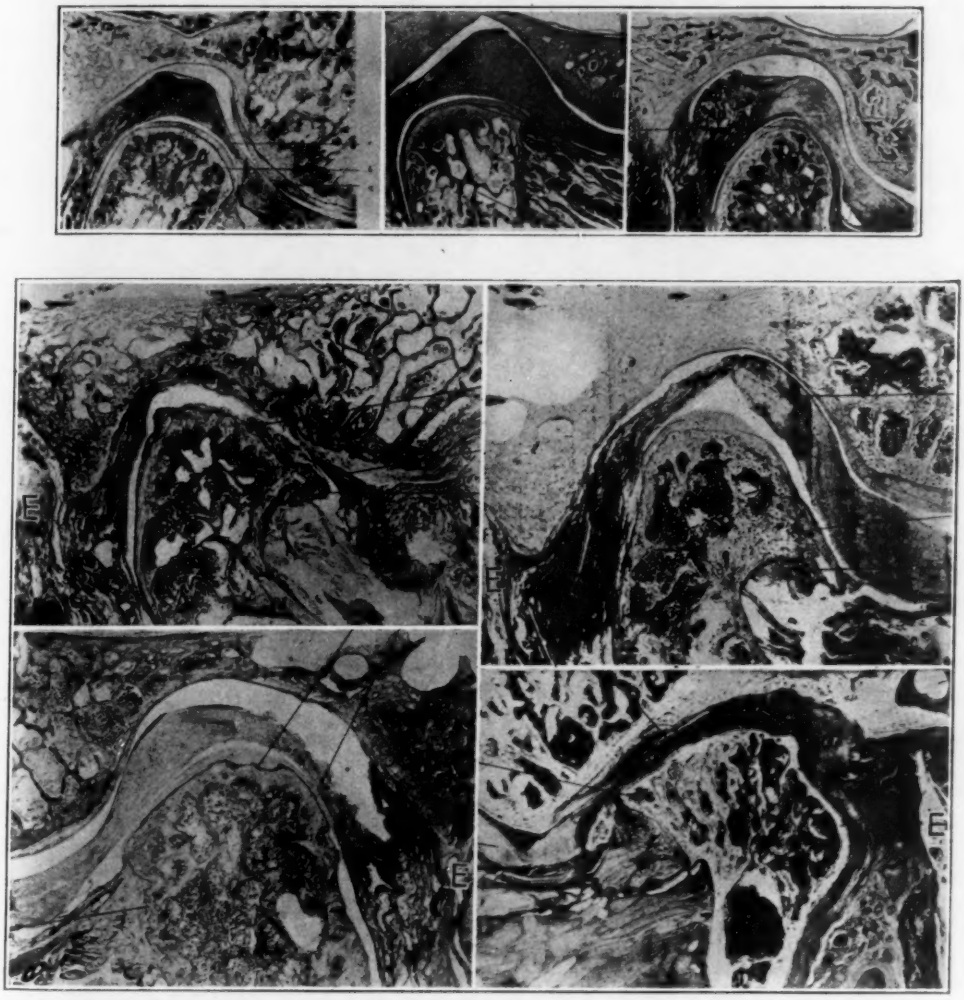

Fig. 5.—First row of histologic sections: three types of normal mandibular joints associated with normal dental bites. These sections show the form and the integrity of the bone of the articulating surfaces and of the meniscus. Second and third rows of histologic sections: mandibular joints associated with abnormal bites resulting from the loss and traumatic articulation of the teeth. These show the deformity and degeneration of the bone, of the articulating surfaces and of the meniscus. These degenerations and the etiologic trauma of the joint occur in the temporal bone which houses the ear as the osseous otic capsule. (From Steinhardt.[12])

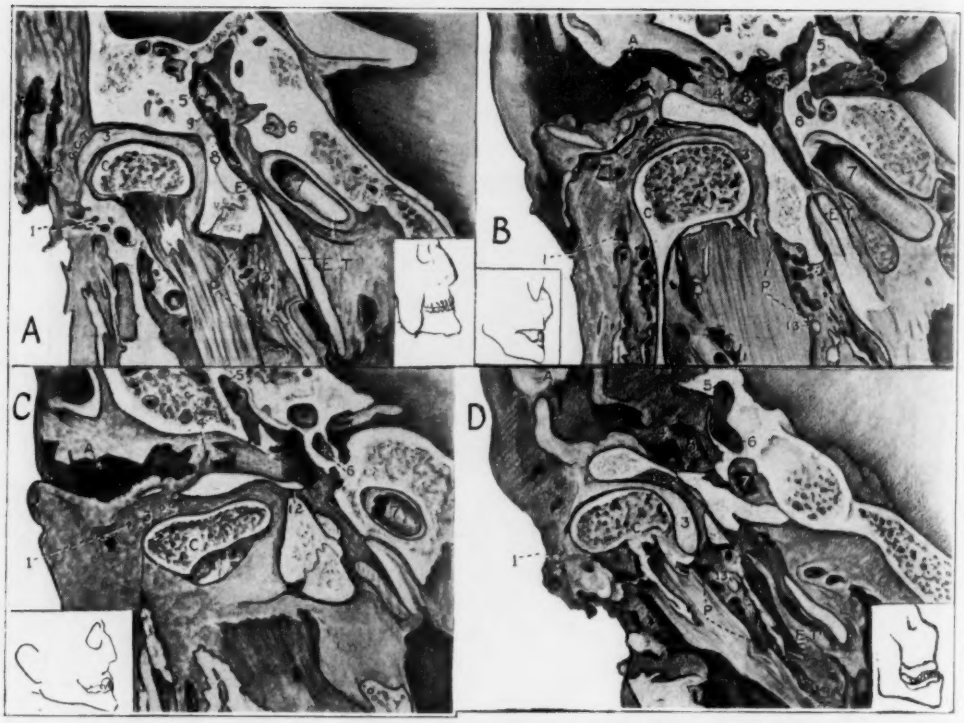

Fig. 6.—Comparison of mandibular joint–ear structures and relationships of cadavers: *A*, normal dental bite; *B*, overclosed dental bite; *C*, overclosed, traumatic dental bite; *D*, extreme overclosed traumatic bite. These show the altered relationships, degenerations and deformities of the external auditory meatus, of the attachment of the tympanic membrane, of the wall of the tympanic cavity and of the eustachian tube that may be caused by the loss and attrition of teeth and the resultant defect of the dental bite.

In *A*, showing the mandibular joint in normal relationship to the middle ear with a sketch of the specimen's normal dental bite, *3* and *C* indicate the interarticular meniscus and the condyle of the joint separated from the tympanic cavity and the eustachian tube by a bony wall marked *5-9-8* (which locate the ossicles of the ear, the petrotympanic fissure and the osseous tube. *E* and *ET* mark the cartilaginous eustachian tube.

B shows the mandibular joint in abnormal relationship to the meatus, the middle ear and the eustachian tube as a result of the loss of the upper teeth—shown in the sketch. The condyle, *C*, is displaced posteriorly, with the meniscus, *3*, displaced medially. The anterior wall of the meatus is compressed, with diminution of its lumen. The bony wall between the ear drum and the tympanic cavity is resorbed by the traumatic pressure of the condyle, and the lateral bony wall of the osseous eustachian tube shows exostosis.

In *C*, showing the mandibular joint in abnormal relationship to the meatus, the middle ear and the eustachian tube as a result of loss of posterior teeth and traumatic articulation of anterior teeth—shown in the sketch—the condyle is displaced mediodistally, compressing, traumatizing and causing resorption of the cartilaginous and bony walls of the meatus and the middle ear and causing exostosis of the medial wall of the osseous eustachian tube. This section shows degeneration and diminished lumen of the osseous eustachian tube.

D shows the mandibular joint in abnormal relationship to the meatus, the middle ear and the eustachian tube as a result of an overclosed, traumatic dental bite in which the upper anterior and the lower posterior teeth are missing—shown by the sketch. Note the posterior displacement of the condyle, *C*; the medial displacement of the meniscus, *3*; the resorption of the bony wall of the middle ear and the osseous eustachian tube, *GCT*; the dimunition of the lumen of the osseous eustachian tube; the detachment and degeneration of the cartilaginous eustachian tube, *ET*; the degenerations of the tympanic membrane and cavity, *4-8*. All these traumatic joint displacements and aural deformities and degenerations were caused by an abnormality of the dental bite resulting from loss and malarticulation of teeth.

and cartilages of the joint caused by dental abnormalities. These deformities and degenerations and the traumatization which is associated with them occur in the petrous portion of the temporal bone, which as the otic capsule contains the vital portions of the ear.

The actual anatomic relationships of the middle ear to the temporomandibular joint and the dental bite are shown by dissections in figure 6.

Figure 6 *A* shows the normal relationship when the dental bite is normal and adequate. The mandibular joint is enclosed posteriorly and medially by a bone partition which also forms the anterior and lateral walls of the middle ear and eustachian tube. This section shows the tympanic cavity and the bony and cartilaginous portions of the eustachian tube. The ossicles of the ear may be seen, and from their location one may judge the close relationship of the temporomandibular joint with the middle ear. The narrowest part of the wall between them is traversed by the glaserian fissure. This transmits the anterior tympanic artery and vein to and from the ear and the temporomandibular joint. It also lodges the processus gracilis of the malleus and transmits the chorda tympani nerve. Just below the glaserian fissure in the bony portion of the eustachian tube are the attachments of the tensor tympani and tensor veli palatini muscles. The former functions in the conduction and modification of sound stimuli. The function of the latter includes drainage of the eustachian tube.

Figure 6 *B* is a section through the similar area of a specimen in which the upper teeth have been lost. This shows the relationship of the temporomandibular joint to the eustachian tube, middle ear and external auditory meatus in a specimen with overclosure of the jaw without traumatic dental articulation. In this dissection the condylar displacement has been directed laterally, so that the major injury has been in the area of the external auditory meatus and the tympanic membrane. There is some evidence of bone resorption in the area of the glaserian fissure and of traumatic alteration of the lateral wall of the bony part of the eustachian tube. This dissection shows that abnormalities of bite may alter the temporomandibular joint–ear relationship so that the deformity and trauma are directed laterally and posteriorly, injuring the external auditory meatus and the tympanic membrane.

Figure 6 *C* is a dissection showing the temporomandibular joint–ear area of a specimen in which the posterior teeth have been lost and the anterior teeth are in overclosed traumatic articulation. This dissection shows alterations of the joint and its relationship to the ear directed medially and posteriorly, causing resorption of the bony wall between the joint and the tympanic cavity and exostosis of the lateral wall of the bony part of the eustachian tube. There is evidence of degeneration in the tympanic cavity and the eustachian tube. This shows that closure of the dental bite with traumatic articulation of the remaining teeth

causes alterations in the temporomandibular joint–ear relationship which, in turn, cause irritation, traumatic injury, resorption and exostosis of the anterior lateral wall of the tympanic cavity and the lateral wall of the eustachian tube.

Figure 6 *D* is a section of the temporomandibular joint–ear area of a specimen with an overclosed traumatic dental bite. This shows an extreme posterior lateral displacement of the condyle, complete resorption of the lateral wall of the bony part of the eustachian tube and degeneration of the cartilaginous part of the tube. There are also destruction of the bony wall between the joint and the tympanic cavity in the area of the glaserian fissure and evidence of degenerations within the tympanic cavity. There are exostosis of the bony wall between the joint and the tympanic membrane, partial occlusion of the external auditory meatus and diminution of the lumen of the bony portion of the eustachian tube. This dissection shows that a traumatic overclosed dental bite may cause extensive pathologic changes of the ear, including degeneration of the cartilaginous, and occlusion of the bony, portion of the eustachian tube.

THE PATHOLOGIC CHANGES OF THE AUDITORY ORGAN CAUSED BY ABNORMAL DENTAL BITES AS CORRELATED WITH AUDITORY CONDITIONS AND SYMPTOMS

The comparative dissections shown in figures 3 to 16, inclusive, demonstrate that the structure and form of the external auditory meatus, the drum, the walls of the tympanic cavity and the eustachian tube are influenced by the dental bite. The pathologic alterations of these parts of the ear include: chronic trauma, injury and displacement of the blood vessels and nerves that supply these parts; degeneration of the anterior wall and reduction of the lumen of the external auditory meatus; chronic irritation of the tympanic membrane and probably of the tensor tympani, tensor veli palatini and stapedius muscle reflexes; degeneration of the anterior-inferior wall of the tympanic cavity and the lateral wall of the eustachian tube, and reduction of the lumen of the bony portion and degeneration of the cartilaginous portion of the eustachian tube. These conditions are pathognomonic of progressive deafness, tinnitus, aural vertigo and otalgia. The manner in which these pathologic conditions predispose to, aggravate or cause various auditory conditions and symptoms probably differs with the individual patient and may be influenced by hereditary response and organic susceptibility. The cause and effect relationship may be the result of disturbances of atmospheric pressure balance or of neurovascular disturbances or of both. It may be that injury to parts of the ear prevents functional fatigue of the ear. This would reduce conduction and cause progressive degenerations in the middle and inner

ear, according to the findings of Hughson, Crowe and others. Or it may be the result of chronic irritation of the stapedius, the tensor tympani and the tensor veli palatini muscle reflexes. This would disturb conduction, according to Wever-Bray [31] and Lindsay,[32] cause degenerations of the organ of Corti, according to Lurie,[4] and interfere with drainage of the eustachian tube, according to Kelly.[28] The injury of and the physical changes in the walls of the tympanic cavity and the eustachian tube may directly cause tubal malfunctions and auditory disturbances. The degeneration in the temporal bone housing the ear, as shown by the histologic sections, may be one of the causes of the changes in the otic capsule found in certain forms of deafness. Specifically, the dissections show that abnormalities of bite "directly affect the eustachian tube and are important etiologic factors in deafness," in accordance with the findings of the Committee on Problems of the Hard of Hearing of the American Medical Association.[2] These same factors may also cause chronic overstimulation of a portion of the organ of Corti, producing the symptoms of tinnitus aurium. They may also cause aural vertigo by disturbing nerve reflexes which, in turn, disturb the otic labyrinth.

My experience during the past twenty years in this work includes the observation and diagnosis of thousands of cases and the treatment of hundreds of patients. My clinical findings show that emotional and fatigue factors are likely to predispose to and aggravate aural vertigo. The treatment and the response of this condition indicate a sensitive threshold between its presence and absence. Aural vertigo caused by abnormalities of dental bite, especially as a part of Ménière's syndrome, responds readily and frequently spontaneously to dental treatment that corrects the abnormal bite. Chronic tinnitus is not curable by treatment of the dental bite, although it can usually be made more bearable and therefore more acceptable to the patient. Progressive deafness of substantial degree and time cannot be cured, and hearing cannot be improved, but the progress of loss of hearing can be slowed, and the loss spread over a longer interval. The mechanical opening of the external auditory meatus and correction of the condylar trauma that result from scientific treatment of the dental bite make a hearing aid much more effective and comfortable. Reduction of auditory acuity in its early stages, if caused by abnormalities of dental bite, can be cured by successful dental treatment. I have reported these facts from time to time with additional proofs, case histories and bibliography.[33]

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31. Wever, E. G., and Bray, W.: J. Exper. Psychol. **31**:35, 1942.

32. Lindsay, J. R.: Labyrinthine Dropsy and Ménière's Disease, Arch. Otolaryng. **35**:853 (June) 1942.

33. Goodfriend (footnotes 1, 7, 8 and 9).

MEDICAL DIAGNOSIS OF DENTAL CONDITIONS THAT CAUSE AURAL DISTURBANCES

These factors of treatment and the alleviation of these otherwise incurable conditions emphasize the importance of a program of prevention. This program is the responsibility of medicine, and the preventive treatment is the responsibility of dentistry. It is essential that the physician fully understand the nature of dental conditions that may cause auditory conditions. There are usually no subjective dental symptoms and no dysfunction. The patient can eat and talk and has no pain in his teeth. The symptoms may or may not be localized in the area of the temporomandibular joint. My experience shows that there may be extreme trauma and pathologic change in the temporomandibular joint without the patient's knowledge or awareness. In many cases a patient whom I successfully treated for aural symptoms and neuralgia was unaware of the abnormality of the dental bite and mandibular joint, despite the fact that the case history frequently associated the beginning of the symptoms with dental treatment, such as the loss of posterior teeth or the making of dental restorations and replacements.

The diagnosis of dental conditions that may be etiologic factors in the auditory conditions is outlined in figure 7, which is the form we used in the otology and speech clinics of the University of Pennsylvania. The procedures include facial measurements, observation of jaw movements, palpation of the mandibular joints during the jaw movements, and examination of the dental bite.

Fascial measurements check the dimensions from the pupil point to the corner of the lips and from the base of the nose to the mental point of the chin. In patients with normal dental bites these dimensions are approximately equal. An abnormal dental bite will show as a diminished comparative dimension from the subnasion to the menton, as illustrated in figure 8.

Observation of jaw movements is accomplished by placing a mark on the menton. This is observed during the patient's slow wide opening and closing of the mouth. Certain abnormalities of dental bite will show as jerky, irregular or laterally diverted movements of the menton during the opening and closing movements of the jaws.

Palpation of the movements of a mandibular joint is accomplished by the operator's placing the small finger in the auditory meatus while the patient goes through the acts of opening and closing the jaws, chewing and swallowing. An abnormal dental bite is manifested by a pressure on the finger during closing movements of the jaws and/or crepitus and trauma may be felt in the joint during the various jaw movements. The operator should then hold his finger tips gently over the joint in front of the aural tragus and have the patient repeat the various jaw movements. An abnormality of the dental bite may cause

the condyle to jump out of place laterally and anteriorly during the wide opening of the mouth, or trauma may be felt during the chewing movements. These procedures are shown in figure 8.

EDWARD C. KIRK DENTAL RESEARCH—UNIVERSITY OF PENNSYLVANIA

PROFS. GEORGE M. COATES and EDWIN B. TWITMYER
DR. DAVID J. GOODFRIEND

Refer patients with negative objective disturbances of the ear and with speech defect associated with abnormalities of the dental bite. The latter include: malocclusion, overclosure of the jaw, loss and attrition of teeth, and inadequate dental replacements.

Procedures in diagnosis of dental abnormalities:

1. Observe the patient's teeth for malocclusion, loss and break-down of teeth.

2. Compare the dimensions from the pupil point to the corner of the lips, and from the base of the nose to the mental point of the chin. Normally these dimensions are approximately equal. In abnormality the distance from the nose to the chin is usually less than that from the pupil point to the corner of the lip.

3. Observe the mental point of the chin during slow opening and closing of the jaws. Normally the chin moves in a straight line. Abnormally the chin may move or snap to either side. The movement of the chin toward either side indicates the retardation of the forward movement of one or both mandibular condyles. Its return to the center line may be gradual or sudden. In the first instance the obstacle which retards the movement is gradually overcome, while in the second the obstacle is suddenly overcome.

4. Feel the movements of the mandibular condyles during opening, closing and masticating movements of the jaw with the tips of the little fingers placed in the external auditory meatus. Normal joints have smooth movements and do not encroach on the lumen of the meatus. Abnormal joints have traumatic, crackly and jerky movements and the condyle can be felt to encroach on the lumen of the meatus.

5. Feel the movements of the mandibular condyles during the opening and closing movements of the jaws with the finger tips placed on the face in front of the tragus of the ear. Normal joints have smooth movements. Abnormal joints are characterized by lateral displacement and traumatic movement of the condyle.

NOTE.—The speech and auditory treatment and check-up of these patients will follow and cooperate with their dental treatment of the abnormalities of bite.

Fig. 7.—Instruction sheet used in ear and speech clinics for selection of patients to be studied by Edward C. Kirk, of the Dental Research Project.

Examination of the dental bite includes observation of the adequacy and the height of the dental support. This is particularly important

in the posterior part of the mouth. It depends on the presence, the axial direction and the integrity of the bicuspid and molar teeth. If several posterior teeth are missing or are broken or ground down or inadequately restored, the dental support may be considered inadequate. If the posterior teeth are undererupted or are tilted abnormally toward the tongue or the cheek, the bite may be overclosed. This would show by a deep overbite of the anterior teeth. The dental arches normally meet so that there is a slight overbite of the upper teeth. Deep overbites, overjets, underbites and crossbites are abnormalities. There should be freedom of movement of the jaws with the teeth in masticatory contact. Otherwise, the bite is locked, and there is a resultant trauma in the mandibular joint–ear area.

Fig. 8.—Method of palpating the mandibular joint during movements of the jaws; measurements to check normal posture of the jaws. Abnormalities of the bite and the joint may be felt as pressure, crepitus or trauma in the auditory meatus and as displacement and jerky movements in front of the ear.

Abnormality of dental bite is diagnosed dentally by means of accurate reproductions of the teeth mounted on a scope in the same relationships as those in the patient's head and also by means of roentgenograms of the mandibular joints.

Roentgenograms of the mandibular joints are accurate aids in the diagnosis of joint and bite abnormalities when correlated with the mounted reproductions of the teeth, the facial measurements and the palpations of the joints. The roentgenologic technic is not complex and requires no lamination or other special procedures. With the cassette held close to the joint of which a roentgenogram is to be taken, the ray is directed from the opposite side at an angle of 20 degrees from the horizontal axis of the upright head and cassette. Views are taken of each joint, one with the bite closed and one with a 1 inch (2.5 cm.) block held between the front teeth. I have devised a ray director that

has simplified this technic. It consists of a plastic cassette holder from the top of which a clear rod projects at an angle of 70 degrees. This rod is therefore 20 degrees from the horizontal of the upright head and cassette. My mandibular joint roentgen ray director is illustrated in figure 9. The roentgen rays are so directed that they are parallel to the projecting rod. The operator can establish this parallelism by sighting the line of ray on his machine through the transparent rod.

The roentgenogram of the normal mandibular joint is illustrated in figure 10. The subject was a man aged 54 with a normal dental bite. This may be accepted as a standard normal and the ideal to be

Fig. 9.—Mandibular joint roentgenographic guide described in the text.

approached in corrective treatment. Abnormalities are shown in figures 11 and 12. These show joints associated with dental malocclusions. That in figure 11 is the mandibular joint of a woman aged 20, with an underdeveloped, retruded lower jaw. Her symptoms included obstructive deafness and disturbed speech kinesthesia. Figure 12 shows the roentgen appearance of the overclosed bite of a man aged 20. His symptoms were those of chronic disarticulation of the jaw. These are extreme conditions. Usually the diagnosis of conditions affecting the mandibular joint cannot be made with roentgenograms alone. These are invaluable in the diagnosis of abnormalities of the joint and the bite but should always be compared with the other diagnostic findings. They should also be used to check the effectiveness of dental treatment.

TREATMENT

The treatment of these dental conditions is difficult and complex. It consists in the reconstruction of the masticating mechanism so as to establish normal mandibular joint relationships and movements, normal intermaxillary relationships and a dental apparatus that articulates in symmetry with the patient's repositioned joints. These dental procedures involve facial and mandibular joint orthopedics. They are termed dentural prosthesis in the replacement of teeth, occlusal reconstruction in the rehabilitation of teeth and orthodontia in the regulation of teeth.

Fig. 10.—Roentgenograms of the mandibular joint of a man aged 54 with a normal dental bite in the closed and the opened bite positions. This is a standard of normality, departures from which are variations of abnormality.

There are fundamental criteria and controls but no successful shortcuts for the establishment of a normal dental apparatus. The definition of a normal dental apparatus is one which feels comfortable, is acceptable to the patient and others from the standpoint of looks, functions satisfactorily in eating and talking and is not a source of disease. Dentistry as a healing art must emphasize the importance of the "source of disease" factor in this definition. Dental malarticulations are a source of disease to the teeth and their supporting structures as in pyorrhea; to the mandibular joints and their neurovascular supply in neuralgias and conditions involving the joints, and to the auditory apparatus in pro-

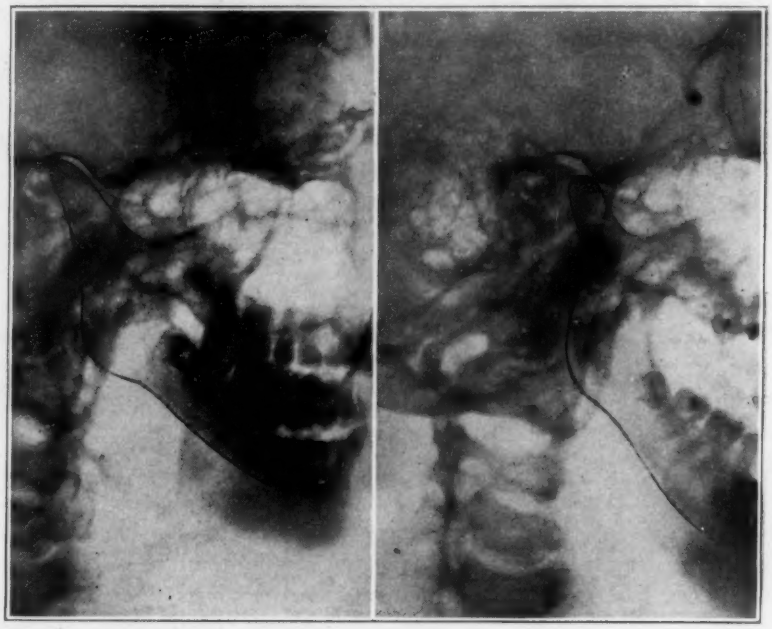

Fig. 11.—Roentgenograms of a mandibular joint showing an abnormal posterior-superior position of the condyle in the closed and the opened position of the jaws caused by an evolutional malocclusion (class II angle). This patient, aged 20, from the speech clinic, was considered as having speech dyslalia and an obstructive type deafness. The abnormalities of the speech, the ear and the mandibular joint were cured by normalizing the dental bite.

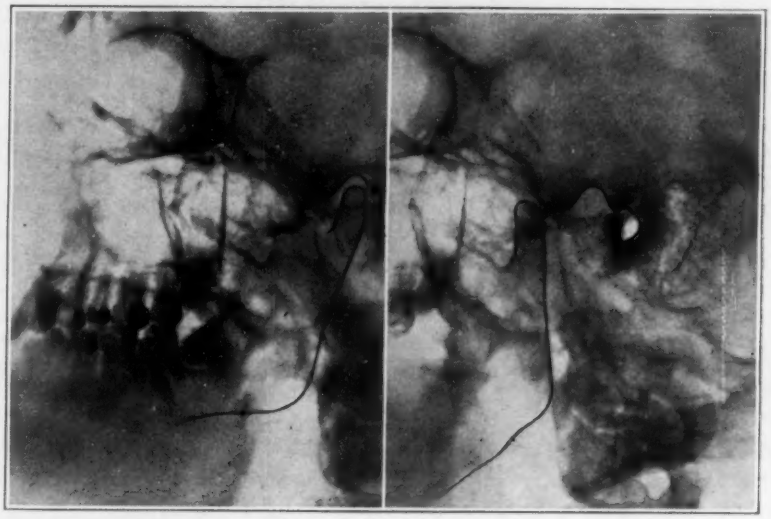

Fig. 12.—Roentgenograms of a mandibular joint showing an abnormal posterior position of the condyle in the closed position of the jaws and an abnormal anterior position in the opened positions, caused by overclosure of the dental bite. This patient, aged, 20, from the student clinic, was considered as having chronic mandibular dysarthrosis.

gressive deafness, tinnitus, vertigo, otalgia, aural eczema and other symptoms and conditions.

Denture prosthesis must provide dentures that posture the jaws normally and provide free and harmonious articulation of the teeth in the various relationships of mastication in order to prevent the foregoing disease conditions.

Occlusal reconstruction must follow the same criteria as denture prosthesis, especially since the new masticating surfaces are attached to the teeth. Under these circumstances, disharmony in articulation would result in increased trauma of the mandibular joint and ear.

Orthodontia must provide mechanical stimulation for the eruption of undererupted posterior teeth. Orthodontic technics that do not correct the abnormal intermaxillary and temporomandibular joint relationships may perpetuate and aggravate conditions that, in turn, may cause aural conditions.

The procedures in which a piece of material is interjected between the teeth, such as that recommended by Costen [24] as a diagnostic procedure, are not satisfactory as treatments of abnormalities of bite. The two factors to be corrected are displacement and trauma. Of these, trauma is most important. Traumatic dental articulation is a more serious threat to the health of the mandibular joint and the ear than is a moderately closed bite. Since these usually occur together, they must be corrected together. Therefore, any medical program of prevention of aural conditions must be based on dental treatment that provides for anatomically and physiologically balanced articulation of the teeth. My methods for such treatment have been and will continue to be published in the dental journals [33] and are shown in the treatment of patients in the following cases.

CASE 1.—Michael G., a watchman 58 years of age, was admitted to the medical clinic of the University Hospital, Dec. 15, 1930, with the following history. For four or five years he had increasing deafness, more marked in the right ear. In February 1930 he had an attack of intense dizziness, nausea and vomiting. There was pain in the upper right abdominal quadrant. These attacks recurred with varying intensity every day or two. They were characterized by a sudden attack of vertigo, followed by pain under the right ribs and intense nausea and vomiting. He was quite well between attacks. On May 16 he was taken to the Lankenau Hospital, where the diagnosis was chronic calculous cholecystitis, and the treatment recommended was removal of the gallbladder. He was next admitted to the University Hospital, where the diagnosis was Ménière's disease with stasis in the duodenum and small intestine. The otoneurologic report, based on Bárány findings of Jan. 17, 1931, was as follows: "The vestibular examination shows definite evidence of some intracranial lesion. The right ear gives poor responses from all its portions, cochlear and vestibular. The left ear produces responses which can be explained only by the presence of some lesion of the brain. The differential diagnosis lies between a slowly growing lesion of the right cerebellopontile angle or possibly a degenerative lesion, perhaps vascular, involving both

sides of the brain stem. The diagnosis is that of a vascular lesion, very likely a tumor on both sides of the brain stem."

The dental history and diagnosis showed that the patient had been wearing full artificial dentures for nine years. Those he was wearing on admission had been made four or five years before, about the time he had first observed auditory symptoms. Facial measurements, illustrated in figure 13, showed that the bite was overclosed 12 mm. by these dentures. Palpation and roentgenographic examination of the mandibular joints revealed that the condyles had been displaced posteriorly and superiorly by the bite overclosure. On Februarv 28 this case was discussed in Dr. Alfred Stengel's medical seminar. I explained the hypothesis of the cause and effect relationship between abnormalities of dental bite and of the mandibular joints and auditory conditions and symptoms. I recommended artificial dentures which would provide for the establishment of the normal anatomy and physiology of the mandibular joint. Dr. P. H. P. Pepper, who was presiding at the seminar, decided that since the choice lay between the comparatively simple treat-

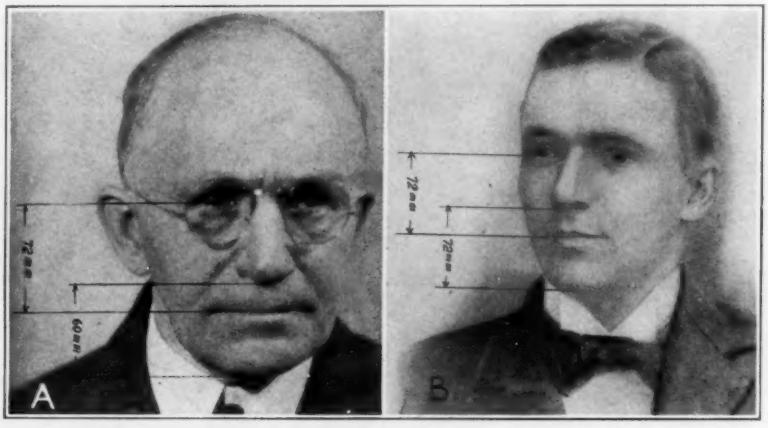

Fig. 13 (case 1).—*A*, Michael G., aged 58, with overclosure of bite caused by inadequate artificial dentures. Note the 12 mm. reduction of dimension from nose to chin. His symptoms were acute vertigo, progressive deafness and tinnitus. The otoneurologist's diagnosis was tumor at the base of the brain, and the clinical diagnosis was cholecystitis. As treatment, however, he was fitted with new artificial dentures, anatomically postured and physiologically articulated. The results were cure of the vertigo and improvement as regards the other symptoms; he required no further otologic or medical treatment. *B*, same patient with natural teeth, showing symmetry of the facial dimensions.

ment of new dentures and the complexity and danger of procedures for the removal of a tumor of the brain it was advisable to try the dental treatment first. Dentures were made on March 8, April 26 and September 2. The patient was observed for five years thereafter. During the period of treatment there were two attacks, one following the insertion of the first dentures and the other following the insertion of the third dentures. During the following year there were no major attacks. There was general improvement during the next four years. The patient returned to his employment, made an overseas trip to his native land and has been well adjusted physically and socially since.

Case 2.—George W., a sheet metal worker aged 49, was admitted to the neurologic clinic of the University Hospital on Jan. 9, 1931. His case history

showed deafness since 1921, more marked in the left ear. Tinnitus of a hissing type started in 1928. In October 1929 he had a severe attack of vertigo. Three months later, in January 1930, the attacks of vertigo became progressively intense and frequent. On the night of January 8 there were four attacks, during which weakness increased until consciousness was lost during the fourth attack.

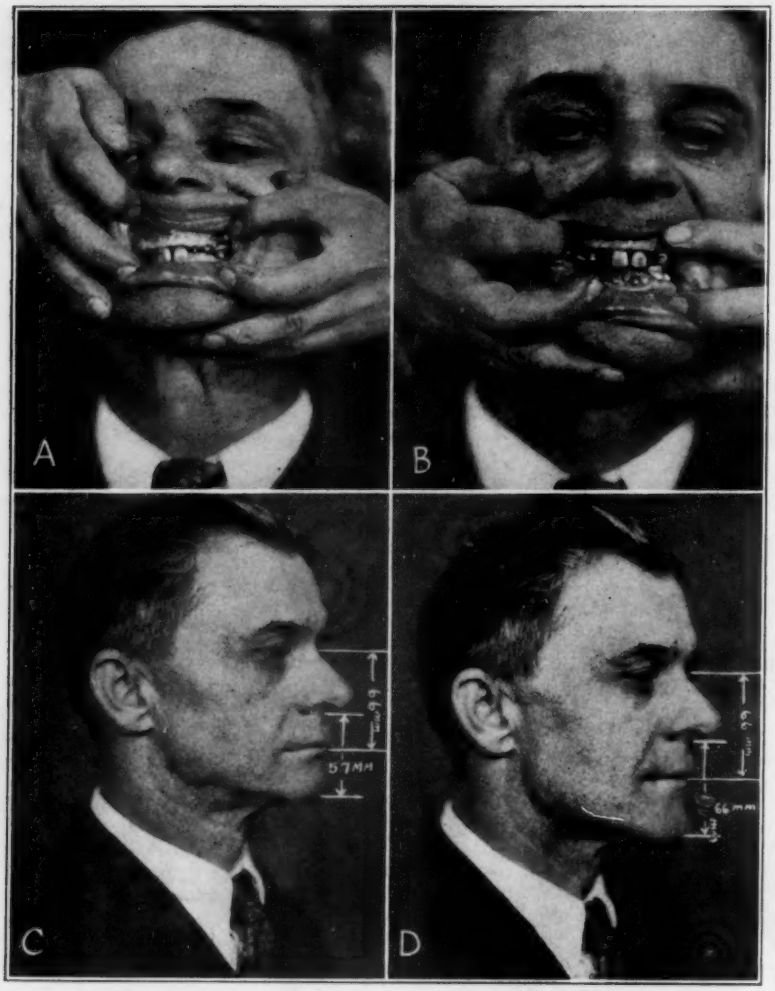

Fig. 14 (case 2).—George W., showing overclosed bite with worn-down teeth, *A*, and reduced dimension from nose to chin, *C*. His symptoms were acute vertigo, deafness and tinnitus. His clinical diagnosis was Ménière's disease. The first phase of his treatment consisted in temporary reconstruction of the bite to establish normal intermaxillary relationships, *B*, and normal facial dimensions, *D*.

The average frequency was three major attacks a week. The neurologic diagnosis was Ménière's disease. The otoneurologic diagnosis, based on the Bárány findings, was toxic bilateral labyrinthitis, more marked on the left side. The dental history and diagnosis showed that the teeth were worn down to the gum

line and that many teeth were infected. Facial measurements showed a bite overclosure of 9 mm. These are illustrated in figure 14 *A*. Palpation and roentgen study of the mandibular joints showed superior-posterior displacement of both condyles and trauma of both joints during jaw movements. His treatment for Ménière's disease was entirely dental. It consisted of two stages. The first stage started in April 1931 and consisted of the establishment of normal intermaxillary, interdental and intra-mandibular-joint relationships by means of metal overlays that were constructed over the patient's worn-down and infected teeth. During this period there was an improvement in the symptoms. The remaining teeth were gradually removed and an autogenous vaccine given, without further improvement. This was completed in September 1931. On October 9 he was referred back to the otologic clinic, where his eustachian tubes were inflated, with excellent results for one day. On October 16 he was discharged from the otologic clinic as incurable. The second stage of treatment consisted in reconstructing his masticating mechanism to anatomic and physiologic normality by means of artificial dentures. This was completed on December 6. These dentures established normal facial dimensions as shown by figure 14 *D* and normal mandibular joint relationships as revealed roentgenographically and by palpation. The following day the patient reported that he could hear the vibration of his voice in his left ear. He had no attacks of vertigo or vomiting during the following year. On Jan. 2, 1932, one year after completion of the artificial dentures, he had an otologic check-up at the otologic clinic of the University Hospital. The findings showed, among other things, that his hearing had improved during the year from a hearing loss of 32.8 per cent to one of 30 per cent in the right ear and to one of from 61.7 to 57.8 per cent in the left ear. During the following four years I checked his symptoms and found that he had since observed an occasional "wooziness" and further loss of hearing but that he had required no further otologic or dental treatment.

These cases show that the symptoms of long-standing deafness and tinnitus with acute vertigo, diagnosed as Ménière's disease or syndrome, may be caused by abnormalities of the dental bite and alleviated by correction of the bite. Acute vertigo was cured by the dental treatment, and the other symptoms improved so that the patients required no further treatment.

Case 3.—Mrs. E., aged 34, was referred for treatment of tic doloureux, trifacial neuralgia of nineteen years' duration. At the age of 15 this patient sought treatment for severe pain in the right side of her face. The medical, roentgenographic and neurologic findings were negative. She was given a month's rest treatment. Her physician suggested at that time that she have her teeth "built up," but nothing was done about it. The pain continued, and at the age of 18 her tonsils were removed, without improvement of her neuralgia. Following this, there started acute dislocations of her right temporomandibular joint with intensification of the pain. Dental treatment was then sought, and the lower right third molar tooth was removed. The luxation of the jaw and the neuralgia continued, becoming progressively worse, and were accompanied by sleeplessness, anxiety and general nervousness. During this period until July 1941, when I first saw this patient, the pain assumed the characteristics of tic doloureux, with the trigger zone in the area of the right mandibular joint. According to the patient, the paroxysm of pain was started by movements of the jaw, as in eating and talking, and frequently was accompanied by violent nausea and vomiting. The period of

greatest susceptibility was that preceding and during menstruation, so that she spent two weeks of each month in bed, during which she was afraid to eat or talk and could not sleep. She also complained of complete occlusion of the right nostril and of headache and parasthesia of the right occipital area.

Dental diagnosis showed an abnormality of the bite characterized by overclosure on the left side, with the left lower bicuspid and molar teeth sharply tilted toward

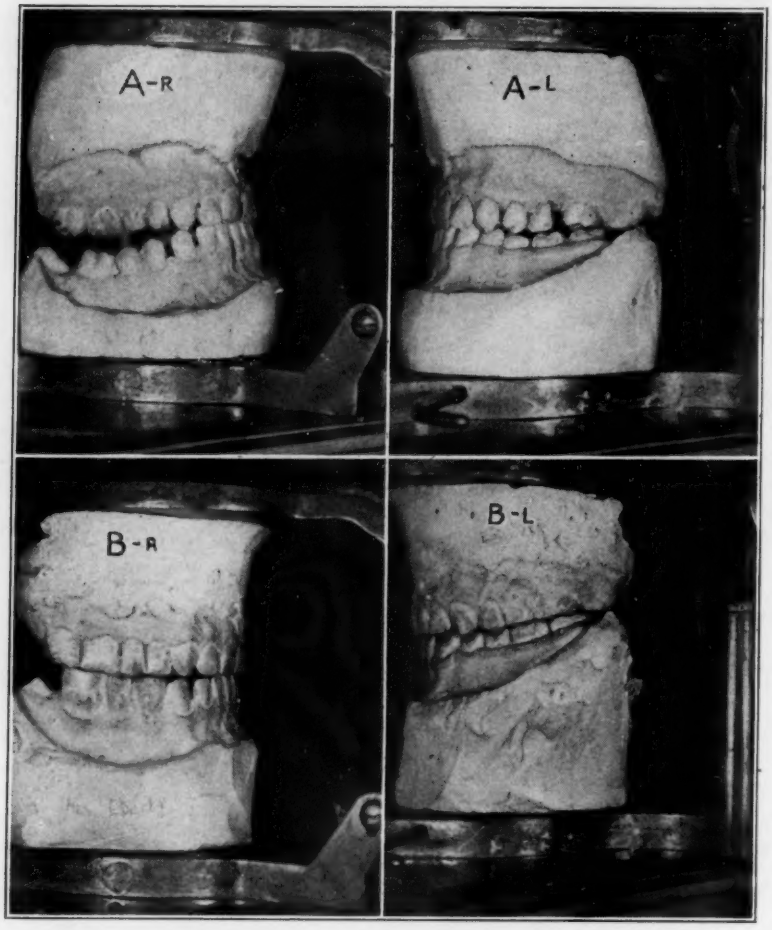

Fig. 15 (case 3).—Reproductions of dental bites: *A-R*, opened bite on the right side; *A-L*, closed bite on the left side.

This patient, from "Round Table Clinic of Dental Items of Interest," had right-sided trifacial neuralgia of nineteen years' duration, progressive separation of the right side of the bite, facial deformity, occlusion of the right nostril, etc. *B-R* and *B-L* show the reconstruction of the bite. This was done in two stages, guided by the requirements for normality of the left mandibular joint.

the tongue, and by an open bite on the right side with progressive space between the biting surfaces of the upper and the lower right bicuspid and molar teeth. This was shown by mounted reproductions of the teeth, illustrated in figure 15 *A*, and

by a frontal roentgenogram of the head, illustrated in figure 16. The roentgen diagnosis of the mandibular joints, illustrated in figure 17 *A*, was that the right condyle had a tumorous overgrowth and that the left condyle, while normal in size and form, was displaced superoposteriorly. My diagnosis, based on roentgen examination and on studies of the model in conjunction with the case history, was that the original abnormality was the traumatic overclosure of the bite on the left side. This displaced both joints but caused the greatest trauma in the right joint, which is the working joint when mastication is done on the left side. This trauma of the right joint caused the right-sided pain and caused the patient to favor that side and eat on the left side. This further traumatized the right joint, which

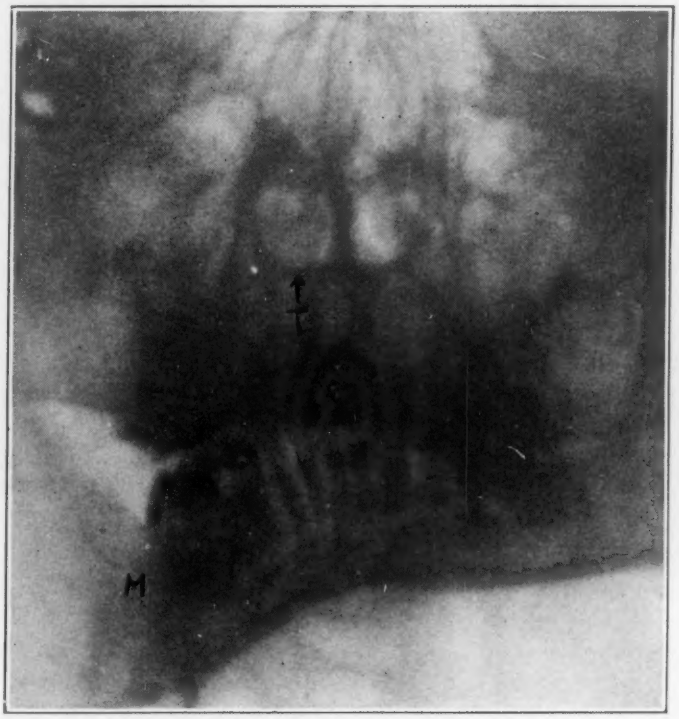

Fig. 16 (case 3).—Frontal roentgenogram of the nose and the maxillomandibular area showing deformity of the mandible, *M*, separation of the bite on the right side and occlusion of the right nostril, *T*.

reacted with an exostosis of the right condyle. The enlargement of the right condyle caused a separation of the biting surfaces of the right bicuspid and molar teeth. This removed the support which these teeth normally afford to the joint and tilted the mandible, increasing the malocclusion on the left side. This vicious cycle increased the trauma of the right condyle and the resultant swelling and pain. As the symptoms became worse, the patient became more discouraged and apprehensive. When I first saw her, she was hopeless, antisocial and melancholy, and told me that she planned to commit suicide if my treatment failed.

The treatment of this patient was entirely dental. As in all abnormalities of bite, the approach was to establish normal mandibular joint relationships and a

chewing mechanism that would function symmetrically with the repositioned mandibular joints. In this case, pathologic developments had completely distorted the right joint beyond the possibility of determining its normal relationships. The left joint was malposed but not distorted. It was taken as the guide for repositioning the mandible. This was achieved by increasing the vertical dimension of the intermaxillary relationship on the left side. This was accomplished by overlays that built up the left upper and lower bicuspid and molar teeth and articulated them so that they would function symmetrically with the left joint. While this increased the opening of the bite on the right side, it eliminated the trauma of

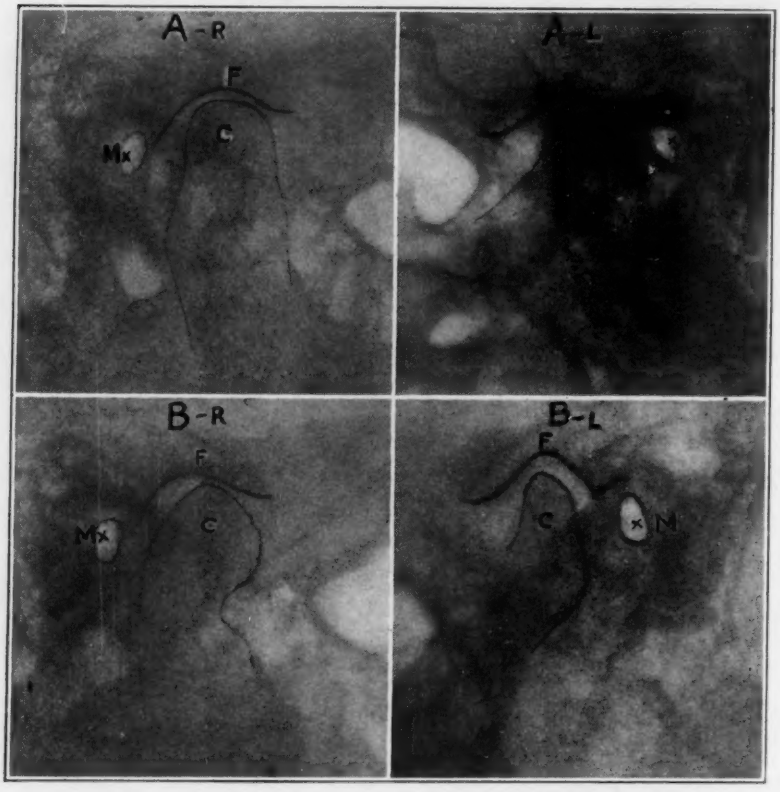

Fig. 17 (case 3).—Roentgenograms of the mandibular joint taken before and after treatment of the bite. *A-R* shows tumorous overgrowth of the right condyle. This was caused by the abnormal bite, and it, in turn, aggravated the abnormality of the bite by separating the bite on the right side and tilting it on the left.

A-L shows the overclosed joint with superoposterior displacement of the condyle.

B-R and *B-L* show the right mandibular joint one year after reconstruction of the bite. Note the altered form and position of the condyles resulting from correction of the abnormality of the bite.

the right mandibular joint. The right bicuspid and molar teeth were also built up with overlays that enabled them to function symmetrically with the left joint. This treatment was done in two stages. The first overlays were cemented over the teeth. These were adjusted and worn for a period of six months and then were replaced by inlays and jacket crowns constructed within and over the teeth.

This is illustrated by figure 15 *B*. The first phase of the dental treatment was done on Aug. 14, 1941. There was a spontaneous cure of all symptoms except the luxation and the occlusion of the nostril. The right-sided facial pain and occipital paresthesia were cured, and the patient slept well that and succeeding nights. During the first week after placement of the overlays the luxation of the jaw stopped and the right nostril opened. The tic doloureux did not recur before, during or after menstruation the first month or any month since. During the past three years this patient has been under observation and periodic roentgen diagnosis. The overgrowth of the right condyle has receded, and normal movements have returned to the joint. This is illustrated in figure 17 *B*. The dental articulation has remained normal as established by the overlays, and the bite has retained its normality. There has been complete freedom from pain and other symptoms. The patient has become a well adjusted wife and mother, who works part time as a telephone operator and does a thoroughly good job in all.

The first 2 patients are presented from among those whom I have treated during the past twenty-one years because their complaints concerned auditory conditions the treatment of which was entirely dental and was done in conjunction with controls of the medical department of the University of Pennsylvania. The third patient shows the intense and devastating symptoms that may be caused by abnormalities of dental bite through disturbances of the mandibular joint. These patients were not aware of this fact, and neither were the physicians and the dentists who had previously treated them. This circumstance is still responsible for the unsuccessful and symptomatic treatment of such patients in the various specialties of medicine and dentistry. The diagnosis of the causative abnormalities is the responsibility of the physician. Their treatment and, more specifically, their prevention are the responsibility of the dentist.

These cases and my clinical experience during the past twenty-one years show that proper dental treatment will cure certain patients with aural vertigo and neuralgia. It will also alter the intensity and the type of tinnitus in certain patients and make it more acceptable to them. In certain patients it will alleviate deafness of short duration and retard the progress of hearing loss in others.

The determination of the statistical role which abnormalities of bite may play in the causation of auditory defects and neuralgia is complicated by the high incidence of abnormalities of bite in the population. A recent survey of the school children of St. Louis showed that 51 per cent had dental malocclusions. My studies of the students of the dental department showed that 55 per cent had dental malocclusions; also, that the average hearing loss of those with dental malocclusions was 13 per cent greater than that of the normal group. Ninety-two per cent of the persons with auditory complaints but with no objective evidence of aural involvement when examined at the otologic clinic of the University Hospital had dental malocclusions or abnormalities of bite. These statistics show the progressive increase of the incidence of abnormalities

of bite from public school to college to the otologic clinic. This progression of incidence is the result of the loss and breakdown of teeth, which intensify preexisting abnormalities. It is important to the subject that malarticulation of the teeth with the reflex symptom complex becomes progressively worse with the ravages of these involutional forces and that the difficulty of successful dental treatment increases therewith. These facts should encourage the earliest practical treatment of dental abnormalities of bite as a preventive procedure and prompt a conservative prognosis for the dental treatment of long-standing auditory conditions. In the latter instance the treatment of an abnormality of the dental bite should be considered on its own merits. If the patient with auditory or neuralgic symptoms also has an abnormal dental bite, this should be treated for the health of the teeth and the underlying tissues and of the mandibular joints. A successful dental result will establish optimal auditory environment by eliminating the pathologic changes and trauma due to the malfunctioning mandibular joints. This is a vitally important measure in the prevention and alleviation of auditory conditions and diseases.

SUMMARY AND CONCLUSIONS

This work is devoted to the subject of abnormalities of dental bite that cause, predispose to and aggravate auditory disturbances and neuralgias. It presents the normal and the abnormal anatomic and physiologic relationships of the dental bite to the temporomandibular joint and of the latter to the external auditory meatus, the middle ear and the eustachian tube.

Dissections of cadavers with normal dental bites and with various abnormalities of bite, roentgenograms, corroborative bibliography, statistics, the pathologic findings as correlated with accepted otologic explanations, and cases in which dental treatment was carried out are presented to prove the scientific validity of the hypothesis that abnormalities of dental bite may cause deafness, tinnitus, vertigo and neuralgias of the head, face and ear.

These show that abnormalities of dental bite cause abnormalities of the structure and of the movements of the mandibular joint and alter its relationships to the external auditory meatus, the middle ear and the eustachian tube so as to cause deformity, injury and degenerations of their walls and to disturb their blood and nerve supplies. This is shown by figures 1 to 6, inclusive, which illustrate the normal and abnormal mandibular joint–ear relationships associated with and caused by abnormal dental bites.

These conditions are pathognomonic of deafness, tinnitus and vertigo, according to the accepted otologic implications of Ballenger's law, the findings of the Committee on the Problems of the Hard of Hearing

of the American Medical Association and those of Crowe, Hughson, Lurie and other workers in the field of otology.

The abnormalities of bite that cause auditory disturbances include overclosed, traumatic and maloccluded articulations of the natural teeth and of artificial replacements. These include evolutional malocclusions, involutional defects of bite resulting from the attrition, disease and loss of teeth, and unscientific or inadequate replacement, reconstruction and regulation of the teeth.

The cases illustrate the method of treatment and show that abnormalities of dental bite caused conditions that were diagnosed medically as cholecystitis, tumor of the brain, Ménière's disease and tic douloureux, all of which were cured by correction of the dental bite.

This work and twenty-one years of clinical experience have demonstrated that the important factors influencing the results of dental treatment of deafness and tinnitus are the type and the duration of the deafness and tinnitus. Obstructive deafness and confused hearing kinesthesia can be cured in early stages, and in children and young adults. Progressive deafness can be alleviated and the progress of the loss of hearing slackened. Tinnitus of long duration can be favorably altered in type and intensity; that of short duration can be cured. Aural vertigo and neuralgias of the trifacial and auriculotemporal nerves can be cured by successful treatment of the abnormality of bite.

Successful treatment of the abnormality of bite reconstructs the dental apparatus in order to establish normal posture of the jaws and the mandibular joints, also an untraumatic symmetric articulation of the teeth. The treatment of abnormalities of bite should be done in all cases for the establishment of the best possible environment of the auditory meatus, middle ear and eustachian tube and for the prevention of auditory disturbances and neuralgias.

The keynote of this work is prevention. Medical recognition of the scientific validity of the dental causes of these otherwise incurable conditions and of the application of the diagnostic procedures presented herewith will place the responsibility for the prevention of these conditions on dentistry. It will encourage further dentomedical cooperation and stimulate scientific progress in dental reconstruction and replacement and in orthodontia as therapeutic procedures in the prevention of deafness, tinnitus, vertigo and trifacial and auriculotemporal neuralgias.

This work has shown the need and the results of cooperation of the dentist, the otologist, the anatomist, the neurologist, the radiologist and the psychologist in studying a phase of medicine.

The dissections were illustrated by Mr. Maulsby Kimball in cooperation with Prof. Eliot R. Clark, of the department of anatomy of the University of Pennsylvania, and were paid for by the Clay-Adam Company, of New York, through the Edward C. Kirk Research Foundation of the University of Pennsylvania.

EFFECT OF VARIOUS SOLUTIONS OF PENICILLIN SODIUM AND PENICILLIN CALCIUM ON THE RESPIRATORY NASAL MUCOSA OF RABBITS

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THE WIDE acceptance of a rationalized form of nasal and sinal therapy can be established only in the event of a clear understanding of the manner in which drugs work. This understanding can be assisted materially by studying the effect of nasal preparations on (1) nasal or sinal mucosa, (2) ciliary motility and (3) the hydrogen ion concentration of the nasal secretions and by noting the production or the absence of local and systemic side effects. Nontoxic nasal medicaments that are compatible with ciliary motility, that do not vary greatly in their hydrogen ion concentration from that of normal nasal secretions (*p*H 5.5 to 6.5) and that are nontraumatizing to the mucous membranes are most useful in the treatment of the nose and the nasal sinuses—for they function on a rational, physiologic basis.[1a]

Although it may be difficult for physicians to believe in retrospect that they were ever deluded, each medical generation is familiar with therapies that have run the gamut of overenthusiasm and disillusionment. Only a few years ago, for example, the introduction of the local use of sulfonamide compounds as prophylactic and curative agents in the treatment of infections of the nose and sinuses was greeted with hosannas. Yet this was not justified in view of the tendency to neglect the fundamental principles underlying rational, physiologic nasal medication.[1b]

Ever since the production of penicillin passed from scarcity to plenty, a steadily increasing stream of clinical reports regarding its local use in

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From the Department of Otolaryngology, University of Illinois College of Medicine.

1. Fabricant, N. D.: (*a*) Nasal Medication, Baltimore, Williams & Wilkins Company, 1942; (*b*) The Local Use of Sulfonamides in Nasal and Sinus Infection: An Analytic Review, Am. J. M. Sc. **206**:546, 1943.

the treatment of infections of the nose and sinuses has appeared in the medical literature. As always, the clinical reports outnumbered and superseded in general interest some of the basic laboratory investigations. Thus, for instance, Lierle and Evers [2] found penicillin solutions (5,000 units per cubic centimeter of isotonic solution of sodium chloride) practically nonirritating to the nasal mucosa, and Proetz [3] found that solutions of penicillin in concentrations of 250 to 500 units per cubic centimeter have no damaging effect on cilia of the respiratory mucosa. The solutions employed by Lierle and Evers were more concentrated than is ordinarily advocated for local application.

Penicillin is most stable at approximately *p*H 6 to 6.5 and will remain therapeutically potent at this value for about a week when stored under conditions of refrigeration. Recently Tremble and Smith [4] described cases of nasal sinusitis satisfactorily treated with penicillin solution by displacement. The solution employed was nontoxic, isotonic, slightly acid (*p*H 6.5) and did not interfere with ciliary motility or injure the nasal mucosa.

Animal experimentation as a basis for observing the local effect on nasal tissues of various nasal preparations is well recognized. In fact, it is highly advisable to determine the effect of such drugs on normal mucous membranes of animals before advocating their widespread usage in human beings. In order to evaluate the effect of various solutions of penicillin sodium and penicillin calcium on respiratory nasal mucosa, the rabbit was selected for the reason given by Gundrum,[5] namely, that it is believed to possess a mucosa more nearly comparable to that of human beings than the mucosa of any other laboratory animal. In addition, since unilateral infections of the upper respiratory tract are seldom seen in rabbits, this assists in the problem of control study when a drug is applied to only one nasal chamber, the opposite side serving as an ideal control for environmental conditions, extraneous infections and possible variations in histologic technic.[6]

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2. Lierle, D. M., and Evers, L. B.: Effects of Certain Drugs upon Ciliary Activity of the Mucous Membrane of the Upper Respiratory Tract, Laryngoscope **54**:176, 1944.

3. Proetz, A.: Cilia and Penicillin, Ann. Otol., Rhin. & Laryng. **54**:94, 1945.

4. Tremble, G. E., and Smith, F.: Nasal Medication in Sinusitis, Canad. M. A. J. **53**:564 (Dec.) 1945.

5. Gundrum, L. K.: Effect of the Newer Sulfanilamide Derivatives on the Nasal Mucosa of Rabbits: Preliminary Report, Arch. Otolaryng. **37**:209 (Feb.) 1943.

6. Butler, D. B., and Ivy, A. C.: Method of Application of Drugs to the Nasal Mucosa: A Comparison of Nasal Drops, Sprays and Inhalers, Arch. Otolaryng. **39**:109 (Feb.) 1944.

METHOD OF STUDY

Twenty-four normal rabbits were employed in this study. The right nasal passages of 21 rabbits received various solutions of the penicillin salts, the left nasal passages serving as a control. Both nasal passages of 3 rabbits were completely untreated and served as an additional control. Each of the treated animals received 4 drops of penicillin solution from a standard dropper three times daily. Seven rabbits received intranasal instillations for thirty days before being put to death; 7 rabbits received instillations for sixty days before they were killed, and 7 rabbits, instillations for 90 days before being killed. The 3 untreated animals were put to death at the end of ninety days.

Fresh preparations of the various solutions were prepared each week, stored under proper conditions of refrigeration and administered to the animals according to the following schedule:

3 rabbits received sodium penicillin solution (1,000 units per cubic centimeter of isotonic solution of sodium chloride)

3 rabbits received calcium penicillin solution (1,000 units per cubic centimeter of isotonic solution of sodium chloride)

3 rabbits received sodium penicillin solution (2,500 units per cubic centimeter of isotonic solution of sodium chloride)

3 rabbits received calcium penicillin solution (2,500 units per cubic centimeter of isotonic solution of sodium chloride)

3 rabbits received sodium penicillin solution (5,000 units per cubic centimeter of isotonic solution of sodium chloride)

3 rabbits received calcium penicillin solution (5,000 units per cubic centimeter of isotonic solution of sodium chloride)

3 rabbits received sodium penicillin solution (1,000 units per cubic centimeter of 1 per cent ephedrine hydrochloride in isotonic solution of sodium chloride)

A member of each of these groups was killed at the end of thirty, sixty and ninety days by means of an intravenous injection of air. After the turbinal structures were removed, sections were prepared for histologic study. Hematoxylin-eosin stain was used.

FINDINGS

Microscopic examination of all the sections under study revealed a striking similarity between the penicillin-treated and the untreated respiratory nasal mucous membranes. The cytologic changes observed in several instances were of a minimal character. The tissues of 1 rabbit receiving 1,000 units of sodium penicillin per cubic centimeter of solution for thirty days showed slight hyperemia, a moderate increase of goblet cells and a slight increase of round cell infiltration in the subepithelial stroma. The nasal tissues of 1 rabbit treated with 2,500 units of calcium penicillin per cubic centimeter of solution for sixty days displayed a moderate increase of goblet cells, a slight increase of round cells in the subepithelial stroma and a small collection of purulent exudate and débris in the nasal cavity. Similar changes were detected in the tissues of 2 animals receiving 1,000 units and 2,500 units of sodium

penicillin per cubic centimeter of solution, respectively, for ninety days. One rabbit getting 5,000 units of sodium penicillin per cubic centimeter of solution for ninety days revealed a slight increase of goblet cells.

Slight hyperemia of both the untreated and the treated turbinal tissues occurred in 1 rabbit given 1,000 units of calcium penicillin per cubic centimeter of solution for ninety days. One rabbit which received 2,500 units of calcium penicillin per cubic centimeter of solution for ninety days displayed a fairly marked increase of goblet cells on the treated side, while the untreated side showed a small collection of pus in the nasal cavity. No abnormality was seen in the tissues of animals receiving 1,000 units of sodium penicillin per cubic centimeter of isotonic solution of sodium chloride with 1 per cent ephedrine hydrochloride.

SUMMARY AND CONCLUSIONS

Animal studies have demonstrated that various solutions of sodium and calcium penicillin (containing from 1,000 to 5,000 units per cubic centimeter) when applied topically to the respiratory nasal mucosa of rabbits every day for thirty to ninety days have an apparently innocuous effect on nasal tissues. It seems that penicillin solutions suitable for topical application in the treatment of nasal and sinal infections are compatible with ciliary activity, have a slightly acid p_H value approximating that of normal nasal secretions, are isotonic and are noninjurious and nontoxic. Other investigators have previously pointed out these findings, largely, however, on the basis of clinical studies.

From our animal investigations and from the clinical reports thus far on record it is reasonable to conclude that penicillin solutions administered topically have no deleterious effect on respiratory nasal membranes.

Dr. Victor Levine gave assistance with the histologic study.

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605 Lincoln Road (Dr. Hollender).

SPONTANEOUS CEREBROSPINAL RHINORRHEA: SUCCESSFUL SURGICAL TREATMENT

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THREE patients who had spontaneous cerebrospinal rhinorrhea have been treated successfully by means of the intracranial surgical procedure described by Adson.[1] All three patients were females who had congenital defects of the cribriform plate of the ethmoid bone. Two of these patients were adults; their bony defects were small, and rhinorrhea apparently had been precipitated by mild infections of the upper part of the respiratory tract. The third patient, who was a child, had a large bilateral defect in the cribriform plate, with a portion of the left frontal lobe herniating into the left nasal canal. In all cases rhinorrhea had continued unabated until it was treated by intracranial surgery. In 1 case intranasal cauterization had been carried out twice but had failed to eliminate the nasal discharge. The cerebrospinal fluid was identified by its physical characteristics and by chemical analysis for sugar. The patients did not have rhinorrhea after their operations, which were performed five, thirteen and nineteen months prior to the time of writing.

REPORT OF CASES

CASE 1.—The patient was a 49 year old woman in whom a mild infection of the upper part of the respiratory tract had developed nine months before she was admitted to the clinic. This had been followed by nasal discharge of a watery fluid, most noticeable when the patient tilted her head forward. When she tilted her head backward, the fluid was discharged postnasally. The amount of fluid thus drained averaged more than 30 cc. in twenty-four hours. Subsequent infections of the upper part of the respiratory tract did not increase or decrease the quantity of fluid discharged.

The results of neurologic examination and of examination of the eyes were objectively normal. The nasal mucosa was pale and edematous bilaterally. Examination of the fluid discharged from the nose revealed that it contained 80 mg. of sugar per hundred cubic centimeters. Roentgenograms of the skull disclosed no abnormality.

From the Section on Neurologic Surgery, Mayo Clinic.

1. Adson, A. W.: Cerebrospinal Rhinorrhea: Surgical Repair of Craniosinus Fistula, Tr. Am. S. A. **59**:457-465, 1941.

Fifteen grains (0.97 Gm.) of sulfamerazine, to be taken by mouth every four hours, was prescribed for the patient. Administration of this drug was started forty-eight hours prior to the operation as prophylaxis against infection. Comparable doses of the same drug were administered after operation for five days. The concentration of sulfamerazine in the blood was 16.5 mg. per hundred cubic centimeters on the third postoperative day.

A Souttar [2] type of bone flap was elevated after a coronal incision of the scalp had been made. The dura was found to be densely adherent to the crista galli, which was large, and on each side there was a narrow fissure into which the dura dipped deeply, forming a dural stalk. Although the fistula was not identified, this dural stalk was considered to enclose the escape route of the cerebrospinal fluid. By stripping the dura back from the cribriform plate and the roofs of both orbits, satisfactory dural closure was obtained by the use of an inner row of continuous chromic catgut and an outer row of continuous silk sutures. Wax was used to obliterate the grooves beside the crista galli.

No recurrence of rhinorrhea was reported nineteen months after the operation.

CASE 2.—The patient was a 49 year old woman who complained of a profuse watery discharge of the right nostril, which was more apparent while she was in a stooping position. This condition had followed a mild infection of the upper part of the respiratory tract and had been present for four months.

Neurologic examination and examination of the eyes revealed nothing abnormal. Dr. H. L. Williams observed a thin, clear discharge flowing from the olfactory cleft in the right nasal canal. This discharge had all the physical characteristics of cerebrospinal fluid. Roentgenograms of the skull were normal.

As a prophylaxis against infection, 15 grains (0.97 Gm.) of sulfamerazine was administered by mouth every four hours, beginning twenty-four hours prior to operation. A similar chemotherapeutic program was continued for six days after the operation.

After a coronal incision had been made, a Souttar type of bone flap was elevated. The dura was stripped from the orbital roof to the cribriform plate on the right. A dense fibrous fistulous tract was seen to extend from the dura through the cribriform plate. This fistula was isolated, ligated with silk and divided. The opening in the cribriform plate was plugged with wax. The use of this unilateral approach permitted sparing of the left olfactory nerve.

Rhinorrhea had not recurred thirteen months later, and the sense of smell was subjectively normal.

CASE 3.—The patient was a 4 year old Norwegian girl (fig. 1) from whose left nostril clear fluid had drained spontaneously since she was 4 months of age. A soft mass in the left nasal canal had been cauterized when she was 7 months old, and the rhinorrhea ceased for two months. Biopsy of a specimen from this mass at that time had been reported to reveal "brain tissue." Three years later a mass again had been removed transnasally, but rhinorrhea had continued and the mass had recurred at the time of the patient's admission to the clinic.

The results of neurologic examination and examination of the eyes were considered normal. Dr. O. E. Hallberg described a large grayish-appearing tumor which filled the left nasal passage and was bathed in clear fluid. Chemical analysis of the fluid discharged showed that it contained 100 mg. of sugar per hundred cubic centimeters. The nasal tumor and a defect of the cribriform plate were visiualized on roentgenologic examination (fig. 2).

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2. Souttar, H. S.: Hunterian Lecture on New Methods of Surgical Access to the Brain, Brit. M. J. **1**:295-300 (Feb. 25) 1928.

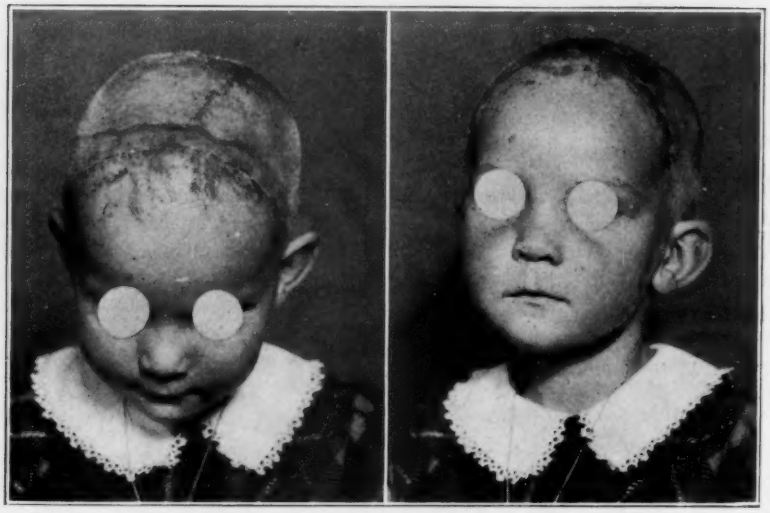

Fig. 1.—The patient in case 3 after operation for encephalocele in the nasal canal. This condition was treated by intracranial resection of the prolapsed brain tissue.

Fig. 2.—Roentgenogram of skull in case 3, made in posteroanterior projection, revealing (*a*) defect in the left side of the cribriform plate of the ethmoid bone and (*b*) encephalocele within the nose.

Three and three-quarters grains (0.24 Gm.) of sulfamerazine was administered prophylactically by mouth four times a day, beginning seventy-two hours before the operation.

After a coronal incision had been made, a Souttar type of bone flap was elevated, so that both frontal lobes and the anterior portion of the longitudinal sinus were exposed. The dura was stripped bilaterally; this disclosed an extensive defect of the cribriform plate, greater on the left than on the right side. A portion of the left frontal lobe extending into the left nasal canal was divided, and the dural edges beneath the frontal lobes were approximated with interrupted silk sutures and a layer of continuous chromic catgut stitches. Several large pieces of fibrin foam saturated with thrombin were placed along the suture line and over the defect in the ethmoid bone.[3]

For four days after operation, 10,000 units of penicillin was injected intramuscularly every three hours. The oral administration of sulfamerazine was resumed on the third postoperative day and was continued for five days. The dosage was the same as that employed before the operation. The abandoned herniated brain tissue in the left nasal canal gradually sloughed exteriorly, and rhinorrhea ceased permanently on the thirtieth postoperative day. During the period of sloughing, a second course of sulfamerazine was administered by mouth when infection in the upper part of the respiratory tract developed, and the nasal slough appeared to be infected.

Five months after operation the patient was well and rhinorrhea was not present.

COMMENT

Two of these cases support the observations of others that infection of the upper part of the respiratory tract may be the precipitating factor in the production of cerebrospinal rhinorrhea in the presence of a congenital defect of the cribriform plate. It would appear that local changes occurring in the mucous membrane of the nose and the overlying meninges as a result of infection lead to perforation of these tissues and to the development of a permanent fistula.

In all cases of suspected cerebrospinal rhinorrhea, thorough neurologic examination and examination of the eyes, nose and throat are indicated. In our case 2 the observation that the cerebrospinal fluid was emerging from only one olfactory cleft made possible a unilateral surgical approach and consequently preservation of the sense of smell on one side. Roentgenograms of the skull and a chemical analysis of the discharged fluid also should be made.

Since the hazard of infection is always present in the repair of nasocranial defects, it is judicious from a practical and from a theoretic standpoint to protect the patient by adequate preoperative and postoperative use of chemotherapy. This procedure was followed in all 3 cases.

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3. Ingraham, F. D.; Bailey, O. T., and Nulsen, F. E.: Studies on Fibrin Foam as a Hemostatic Agent in Neurosurgery, with Special Reference to Its Comparison with Muscle, J. Neurosurg. **1**:171-181 (March) 1944.

The Adson technic, which was followed in a general way, provided excellent exposure of the pathologic process and permitted satisfactory closure, since sufficient dura could be free for this purpose. Experience in the third case indicates that for encephalocele occurring within the nasal canal the procedure of choice is intracranial incision and repair of the dural defect. The prolapsed brain tissue within the nasal canal, thus deprived of its blood supply, will slough exteriorly. Surgical attack by the nasal route is likely to result in failure, and it is also associated with greater risk to the patient.

MASSIVE ATELECTASIS FOLLOWING TONSILLECTOMY UNDER LOCAL ANESTHESIA

Report of a Case

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ATELECTASIS is the term applied to incomplete aeration of a lung or part of a lung. It is derived from two Greek words—ἀτελης incomplete, and ἔκτασις extension. From conception to death the only time that atelectasis may be considered normal is when it is seen in the unborn fetus. There it exists in a perfect state. It most frequently occurs as a postoperative complication but it may occur as a manifestation of a bronchopulmonic disorder or it may follow a trivial accident. The incidence of atelectasis has been variously reported as causing from 3 to 70 per cent of all postoperative complications, with a 40 per cent mortality among those affected.[1]

Of all complications following surgical procedures, those involving the lung are the most feared and the most commonly reported.[2]

Massive pulmonary collapse was recognized as such as early as 1823, when Jorg described the incompletely aerated lung of the newborn and coined the word "atelectasis." Nineteen years later, in 1844, Traube showed that on resection of the recurrent laryngeal nerve or the vagus buccal secretion entered the trachea and that this was followed by atelectasis. In 1854 a British physician named Gardner recognized that atelectasis occurred in a variety of cases and considered bronchial obstruction to be the primary cause. It was not until after the work of Bibergeil in 1905 and W. Pasteur in 1908 that such a condition was considered in the literature regarding postoperative pulmonary complications.[3]

Coryllos and Birnbaum,[4] who have done much work on massive pulmonary collapse, concluded that there is only one cause and that is "bronchial obstruction with absorption of air distal to the obstruction."

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1. Elkin, D. C.: Postoperative Pulmonary Complications, Surg., Gynec. & Obst. **70**:491-493 (Feb.) 1940.

2. Adams, W. E.: Thoracic Surgery: Postoperative Pulmonary Atelectasis, Am. J. Surg. **56**:180-191 (April) 1942.

3. Anglin, A.: The Management of Massive Pulmonary Collapse, Ontario M. Rev. **2**:133-141, 1944.

4. Coryllos, P. N., and Birnbaum, G. L.: Syndrome of Pneumococcic Bronchial Obstruction, Arch. Int. Med. **51**:290-323 (Feb.) 1933.

Lee, Tucker and Clerf [5] were able to produce atelectasis in dogs by instilling bronchial secretion that they had aspirated from persons suffering from atelectasis and reinstilling this material in the bronchi of dogs.

Van Allen and Adams,[6] in their attempt to produce atelectasis in dogs by destroying a ring of epithelium in the bronchi with a caustic, made observations which are a bit different from those in clinical experience. They observed that in their dogs deep breathing and coughing tended to produce atelectasis. Another observation that was interesting was that if a distal portion of the lung had been closed off by complete cicatrization and scar formation the lung would float.

DeTakats, Fenn and Jenkinson,[7] in 1942, agreed substantially that the cause of atelectasis is obstruction due to massive secretion.

Hilding,[8] in his experimental work with chickens and dogs, was able to demonstrate conclusively that the cilia played a vital part in producing negative pressure distal to the plug of mucus.

Wilmer and his associates [9] called attention to the surprising incidence of allergy and asthma in a small group of 10 patients who had postoperative atelectasis.

A brief résumé of some of the physiologic conditions of a normal lung may help in throwing light on the cause of collapse. On the average, alveolar air is composed of oxygen (14.2 per cent), carbon dioxide (5.5 per cent) and nitrogen, including rare gases (80.3 per cent). The air within the lung is in direct contact with the atmosphere and is at a constant pressure of approximately 760 mm. of mercury. All the gases are present in the blood in proportion to the partial pressures of the gases in the alveoli except oxygen and carbon dioxide, which, owing to the changes in the body tissue, are not in proportion.[10]

From a clinical and roentgenologic standpoint the diagnosis of frank atelectasis is simple. There is still, however, some controversy as to the cause and the pathogenesis of this condition. It occurs most frequently following an abdominal operation, particularly one involving the upper part of the abdomen. The type of anesthesia may play a

5. Lee, W. E.; Tucker, G., and Clerf, L. H.: Postoperative Pulmonary Atelectasis, Ann. Surg. **88**:6-14 (July) 1928.

6. Van Allen, C. M., and Adams, W. E.: Mechanism of Obstructive Pulmonary Atelectasis, Surg., Gynec. & Obst. **50**:385-396 (Feb.) 1930.

7. deTakats, G.; Fenn, G. K., and Jenkinson, E. L.: Reflex Pulmonary Atelectasis, J. A. M. A. **120**:686-690 (Oct. 31) 1942.

8. Hilding, A. C.: The Role of Ciliary Action in Production of Pulmonary Atelectasis, Ann. Otol., Rhin. & Laryng. **52**:816-833 (Dec.) 1943.

9. Wilmer, C.: The Incidence of Allergy and Asthma in Postoperative Collapse, Ann. Surg. **91**:651 (May) 1930.

10. Brewerton, D. A.: The Physiology of Atelectasis, McGill M. J. **14**:409-414, 1945.

role, ether having a tendency to excite bronchial secretion and edema. Curiously enough, in the experience of Brunn [11] atelectasis is as common after spinal anesthesia as after inhalation anesthesia. Scrimiger [12] reported a case of collapse following hemorrhoidectomy. Cases have been reported in which the condition occurred after a fall from a horse or a bicycle without the fracture of a bone or even a trivial bruise.[13] Among the predisposing causes that may favor atelectasis are oral sepsis, acute or chronic infections of the upper respiratory tract, shock and possibly allergy.

As regards treatment, it has to be divided into two phases: first, prophylaxis, which means picking the patient, eliminating oral sepsis, not operating in the presence of an infection of the upper respiratory tract except in emergencies, and the use of a competent and well trained anesthetist; and second, relief of the bronchial obstruction. This may be accomplished occasionally by posture, deep inhalation or coughing. Grandstaff [14] has recommended that a 5 to 10 per cent solution of cocaine hydrochloride be applied in the piriform fossa. I see no objections to trying this procedure. In regard to the passing of a soft rubber catheter into the bronchi, I feel that there is considerable danger of traumatizing the trachea and bronchi. There is but one treatment that is sure not to fail and that is fraught with little danger, namely, bronchoscopy and aspiration.

After reviewing all these reports and compiling all the facts one should certainly not expect such a complication to follow tonsillectomy performed with the patient under local anesthesia. Nevertheless, such a complication did occur in a patient of mine within twenty-four hours after operation. The roentgen findings and the signs and symptoms were so pathognomonic as to leave no doubt as to the correctness of the diagnosis. In searching the literature for the past forty years I have been able to find only 1 other case reported. This was recorded by Iglauer [15] in 1937. He mentioned the fact that Drs. H. Goodyear and W. S. Middleton each had encountered a similar complication. Dr. L. H. Clerf [16]

11. Brunn, H.: Collapse.: Pulmonary Postoperative, in Piersol, G. M.; Bortz, E. L., and others: Cyclopedia of Medicine, Philadelphia, F. A. Davis Company, 1933, vol. 8, pp. 379-388.

12. Scrimiger, F.: Postoperative Massive Collapse of the Lung, Surg., Gynec. & Obst. **31**:486 (June) 1921.

13. Lord, F. T.: Collapse: Pulmonary, in Piersol, G. M.; Bortz, E. L., and others: Cyclopedia of Medicine, Philadelphia, F. A. Davis Company, 1933, vol. 8, pp. 364-378.

14. Grandstaff, E. H.: A New Treatment for Postoperative Pulmonary Collapse, Arch. Surg. **51**:237-243 (Nov.-Dec.) 1945.

15. Iglauer, S.: Pulmonary Collapse Following Tonsillectomy Under Local Anesthesia, Arch. Otolaryng. **25**:382-388 (April) 1937.

16. Clerf, L. H.: Personal communication to the author.

stated to me that a patient was brought to him forty-eight hours after tonsillectomy with a diagnosis of atelectasis, which was apparently confirmed by roentgenogram. The history was that twenty-four hours after operation the patient had had an apparent postoperative hemorrhage. He was given sedation. The tonsillar fossa was examined, but no bleeding was manifest. Bronchoscopy revealed a blood clot completely blocking the left bronchus. On its removal the lung reinflated. The next day roentgen examination revealed a large cavity of the upper lobe, and a diagnosis of tuberculosis was made. This was confirmed later by physical examination and by analysis of the sputum.

REPORT OF CASE

V. T., a white woman aged 25, an actress, was first seen by me on July 20 with a history of persistent cough of one year's duration, which she said was the result of catching a cold one year previously after a dress rehearsal. She gave a history of recurrent sore throat and tonsillitis. On examination I found large hypertrophied tonsils and bilateral cervical adenopathy.

Four years previously she had consulted an internist for acne of the face and chest and recurrent sties. At that time physical examination of her heart and lungs disclosed no abnormality. She was 12 pounds (5.5 Kg.) overweight. Her blood and urine were normal. Three years previously she had been treated for angioneurotic edema. She was not seen again until two weeks previous to operation, at which time her chest, heart and blood pressure were normal. A roentgenogram showed slightly increased hilar shadows on the right side (fig. 1 *A*).

She was admitted to the Episcopal Eye, Ear and Throat Hospital on July 28 with a pulse rate of 84, a respiratory rate of 18 and a temperature of 97. She was given sodium amytal, 3 grains (0.19 Gm.), one and one-half hours before operation, followed by morphine sulfate, 1/6 grain (0.011 Gm.), with atropine sulfate, 1/150 grain (0.43 mg.), thirty minutes before operation. The operation was performed at 8:30 a. m.; anesthesia was induced by infiltration of a solution containing procaine hydrochloride, 0.01 Gm., and epinephrine hydrochloride, 0.00002 Gm., per cubic centimeter (concentrations of 1 per cent and 1:50,000, respectively).

During the operation, there was an average amount of bleeding which was readily controlled without ligature or stitches.

On her return to her room the patient seemed comfortable until about 12 noon, when she complained of pain in her throat, at which time she was given "pantopon" (a mixture of hydrochlorides of opium alkaloids), 1/6 grain (0.011 Gm.). There was no coughing or bleeding during the day or further complaint. At 8 p. m. she was given 1½ grains (0.097 Gm.) of sodium amytal. At 11:30 that night she complained of precardial pain, but nothing further was heard from her until early next morning, at which time she complained of severe pain in the right side of the chest and some coughing and had a temperature of 101.2 F., a respiratory rate of 32 and a pulse rate of 108.

Physical examination at this time reaveled diminution of breath sounds and of whispered voice over the entire right lung with decreased tactile fremitus and an impaired percussion note. The apex beat was over to the right, almost in the midline. A roentgenogram was promptly made which showed the right lung to be collapsed, the margin of the heart well over to the right, and the intercostal spaces narrowed, with marked elevation of the right side of the diaphragm (fig. 1 *B*).

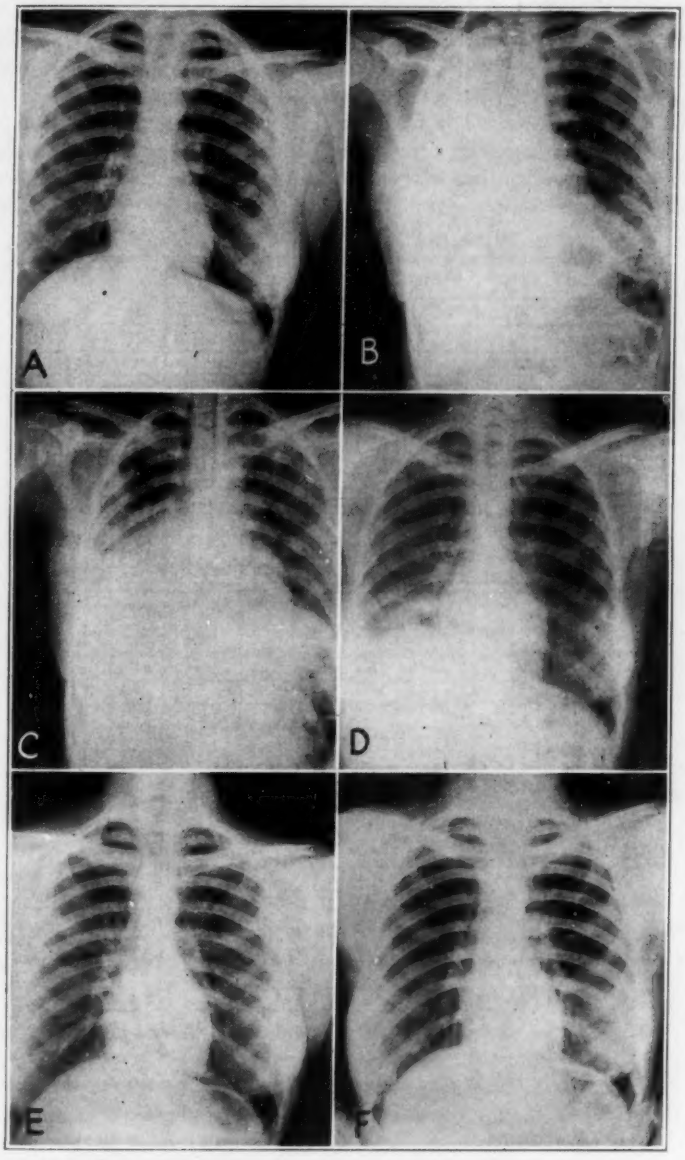

Fig. 1.—*A*, roentgenogram taken two weeks previous to tonsillectomy, showing the hilar shadows of the right side slightly enlarged.

B, roentgenogram taken twenty-four hours after tonsillectomy, showing the right lung collapsed and the margin of the heart moved over to the right.

C, roentgenogram taken twenty-four hours after bronchoscopy, showing the diaphragm descended, the heart returning to the left side and the right lung about 50 per cent aerated.

D, roentgenogram taken seventy-two hours after bronchoscopy, showing the right lung practically completely reinflated, the heart in normal position and the diaphragm descended.

E, roentgenogram taken six months after collapse, showing no residual effects.

F, roentgenogram taken twelve months after collapse, showing a normal chest.

At 3:30 of the same afternoon bronchoscopy was performed by Dr. Daniel Bruce Moffett, with the patient under local anesthesia. The right main bronchus was found to contain a bloody mucous plug, which was aspirated. The left main bronchus was apparently normal. Immediately after this the patient showed considerable improvement. The temperature began to fall, the breathing became easier, and the pulse and respiratory rates both fell rapidly. After bronchoscopy the patient was placed on her left side and encouraged to take deep breaths and to cough out any secretion. At the end of twenty-four hours a roentgenogram

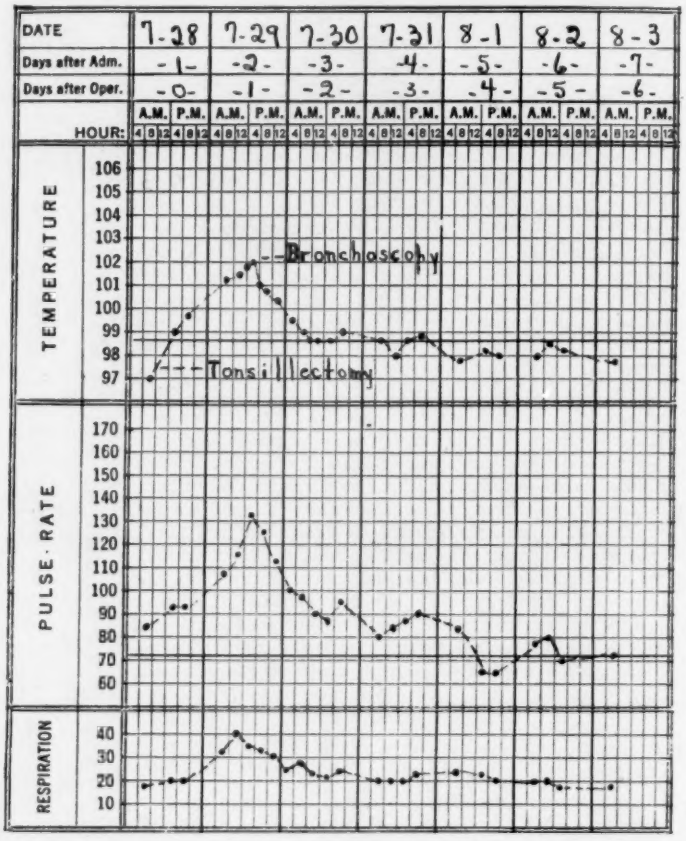

Fig. 2.—The effect of bronchoscopic aspiration on the temperature, the pulse rate and the respiration in the case of post-tonsillectomy pulmonary collapse.

was taken which showed that the lung was about 50 per cent aerated. The diaphragm had descended a little, and the heart had started back to its normal position (fig. 1 *C*). Seventy-two hours after bronchoscopy a roentgenogram was taken which showed the lung practically completely reinflated, the heart in a normal position and the diaphragm descended (fig. 1 *D*).

The leukocyte counts were as follows: on the day of bronchoscopy, 15,800, of which 85 per cent were polymorphonuclear; July 30, 15,600, of which 82 per cent were polymorphonuclear; August 2, 10,800, of which 70 per cent were polymorphonuclear; August 3, 8,800, of which 68 per cent were polymorphonuclear.

The patient was discharged on August 3 in good condition. She returned to the stage in October. She was not heard from again until December 30, at which time the fifth roentgenogram was made (fig. 1 *E*). She returned for a final check-up one year after the date of her bronchoscopy. Physical examination gave negative results, as did roentgen examination (fig. 1 *F*). The patient was never tested for allergy, but so far as I know there was no indication of asthma or allergic involvement.

COMMENT

Having presented the case of atelectasis, I feel that the various factors that favor the occurrence should be considered. The patient was an actress, high strung and nervous. She was given more than the average preoperative sedation. Despite this she did not sleep during the day but required "pantopon" three and a half hours postoperatively. Her sedation plus her fear of pain from coughing may have favored the inspiration of blood and saliva which acted as a nucleus. It should be recalled that the plug in her bronchus did contain some blood.

There was no apparent element of shock present, and so far as I know she was not allergic.

So far as the pathogenesis of the atelectasis is concerned I am convinced that the patient aspirated some blood, which, in combination with her excessive mucous secretion, blocked the right main bronchus, and this, aided by ciliary action plus absorption of air distal to the plug, caused her collapse.

SUMMARY

A brief résumé of the literature on the pathology and the physiology of postoperative collapse is given.

The question arises as to the relationship between post-tonsillectomy abscess of the lung, infarct and atelectasis.

One has to admit that one of the safest, surest and best methods of treating collapse of a lung is bronchoscopy with visual aspiration.

Finally, a case is reported in which a most serious complication (massive atelectasis) followed a common and apparently safe surgical procedure.

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SENSITIVITY FROM INSUFFLATION OF THE POWDERED SULFONAMIDE COMPOUNDS IN ACUTE INFECTIONS OF THE NOSE AND THROAT

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THE LOCAL use of the sulfonamide compounds in treating acute infections of the nose and throat has received much attention in the last three or four years. The soluble sodium salts of the sulfonamide compounds, especially sodium sulfathiazole, had the earliest [1] and formerly the most frequent use. The principal objection to the soluble sodium salts is their high alkalinity (p_H 10 to 11), whereas the p_H range of normal mucous membrane in situ in man is from 5.5 to 6.5 (Fabricant [2]). The 2.5 per cent solution of sodium sulfathiazole in a 0.125 per cent solution of the vasoconstrictor *dl*-desoxyephedrine hydrochloride is still more alkaline (p_H 8.6 to 9.2) than the normal nasal mucosa. Callomon [3] observed that this solution produced inflammation and partial caustic effects and that a 2 per cent solution of "diasone" (the disodium formaldehyde sulfoxylate derivative of diaminodiphenylsulfone) with acid properties (p_H below 5) caused greater damage to the nasal mucous membrane of normal mice than a 3 per cent solution of the same compound, which was alkaline (p_H 8.8). A 3 per cent solution of sulfathiazole in propylene glycol, with a p_H value near the physiologic p_H range of the nasal secretion in man, showed the least irritating effects. Yonkman and associates [4] also found the 3 per cent solution of sodium salts with propylene glycol as a menstruum

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From the Department of Otolaryngology, Northwestern University Medical School.

Read at the meeting of the American Laryngological Association, Chicago, May 30, 1946.

1. Turnbull, F. M.: Intranasal Therapy with Sodium Salt of Sulfathiazole in Chronic Sinusitis, J. A. M. A. **116**:1899 (April 26) 1941.

2. Fabricant, N. D.: Significance of the p_H of Nasal Secretion in Situ, Arch. Otolaryng. **34**:150 (July) 1941.

3. Callomon, F. T.: Tissue Changes Produced in the Nasal Mucous Membrane of Normal Mice by Prolonged Local Administration of Some Solutions Containing Sulfonamide Compounds, Arch. Otolaryng. **43**:31 (Jan.) 1946.

4. Yonkman, F. F.; Craver, B. N.; Lehman, A. J., and Chase, H. F.: Propylene Glycol as a Menstruum for Sodium Sulfathiazole, J. A. M. A. **118**:1317 (April 11) 1942.

well tolerated. Hunnicutt [5] reported a marked inflammation of the mucous membrane of mice during the first three days from a 5 per cent solution of sodium sulfathiazole. Therefore, it may be concluded from the work done up to the present that excessive alkalinity or acidity of the solutions or other preparations of sulfonamide compounds should be avoided.

A suspension of the microcrystalline form of the sulfonamide compounds in isotonic solution of sodium chloride would not have the objection of excessive alkalinity or acidity. If these drugs are suspended in other menstruums, any irritation caused in the mucous membrane would depend on the substance used. Kully [6] observed that when vasoconstrictor drugs are added, particularly to solutions of sulfathiazole, the irritating properties of the preparation are generally increased. Lierle and Evers [7] found that when chlorbutanol was used as a preservative in various solutions or suspensions the ciliary activity was stopped. A freshly prepared isotonic solution of ephedrine sulfate was found more satisfactory as a menstruum.

Another valid objection to the use of the various solutions, suspensions or compounds would be the possible lack of a concentration of the sulfonamide compound that would be sufficiently bacteriostatic. When used as drops, gargles, lozenges or chewing gum, the preparation may not reach a large enough area to be effective.

With regard to the nose and throat, the insufflation of the powdered sulfonamide compounds would seem to be the best answer to these various objections, as it carries the drug in sufficient concentration to the maximum area, is not irritating to the mucous membrane because of excessive alkalinity or acidity and from the evidence at hand does not stop or slow ciliary activity. Lierle and Evers [7] found that sulfanilamide, sulfathiazole and sulfadiazine powders left in contact with the mucous membrane for varying lengths of time (five to sixty-five minutes) neither stopped nor slowed ciliary activity. Clinical observations indicate that the powder remains on the nasal mucosa much longer than a suspension of the microcrystals.

The sulfonamide compounds, in whatever form used, have no inhibiting action on the viruses initiating the common cold and influenza. However, the activated secondary pathogens, most commonly found in acute infections of the upper air passages, such as the beta hemolytic and other streptococci, pneumococci and Staphylococcus aureus, are

5. Hunnicutt, L. G.: Reaction of Mucous Membrane to Five Per Cent Solution of Sodium Sulfathiazole, Arch. Otolaryng. **36**:837 (Dec.) 1942.

6. Kully, B. M.: The Use and Abuse of Nasal Vasoconstrictor Medications, J. A. M. A. **127**:307 (Feb. 10) 1945.

7. Lierle, D. M., and Evers, L. B.: Effects of Certain Drugs upon Ciliary Activity of the Mucous Membranes of the Upper Respiratory Tract, Laryngoscope **54**:176 (April) 1944.

inhibited if sufficient concentration of the drug is obtained over long enough time. Haemophilus influenzae and hemolytic staphylococci are also inhibited, but to a lesser degree. Novak [8] found that the local application of the sulfonamide compounds was bacteriostatic to all species of pathogenic bacteria if sufficiently high concentrations were attained.

During a period of three years, from July 1, 1943 to July 1, 1946, approximately 6,000 insufflations of powdered sulfonamide compounds, used singly or in various combinations, have been administered to approximately 1,500 persons for various types of acute infections of the nose and throat. An average of about 2.5 treatments were given for each acute attack. Many of the patients have had two, three or more attacks during the three year period.

Over the first eight months powdered sulfathiazole alone was used.[9] During the second eight months equal parts of sulfathiazole and sulfanilamide were the agents. Sulfanilamide is the most soluble of the sulfonamide compounds, and it was thought that this factor might have some value in the treatment of acute infections of the upper respiratory tract. However, from a clinical point of view no increased therapeutic advantage was noted. The principal fault of sulfanilamide was the bitter taste to which most patients objected. For a short period (one month) equal parts of sulfathiazole, sulfanilamide and sulfadiazine were employed. During the remainder of the three year period equal parts of sulfathiazole and sulfadiazine were used with more satisfactory results.

METHOD OF TREATMENT

The nasal cavities were first sprayed with a 1 or 2 per cent isotonic solution of ephedrine hydrochloride. This was done to obtain sufficient shrinkage of the turbinates for a maximum distribution of the powdered sulfonamide compounds. Standard De Vilbiss powder blowers, motivated by compressed air, were used to insufflate the powder into the nose, nasopharynx, pharynx and to some extent into the larynx until the visible mucosa was covered by a thin chalk-white film. If tonsils were present, an effort was made to blow some of the powder into the crypts. Care was taken to avoid "piling up" the powder in the nose or the larynx, as a foreign body type of discomfort was occasionally noted for a short time if this occurred. Otherwise discomfort was absent except that there was a feeling of dryness in the nose for a short time. If the patient inhaled while the powder was being insufflated, a tickling cough occurred as from breathing any dusty substance.

The amount of powder used at any one treatment was difficult to estimate but was probably much less than 0.3 Gm., as 1 pound (453.5 Gm.) of the powder was sufficient for more than 1,500 treatments. Much of the substance did not adhere to the mucosa but was exhaled or was returned by the compressed air stream.

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8. Novak, M.: Specific in Vitro Action of Sulfonamide Compounds on Pathogenic Organisms, Ann. Otol., Rhin. & Laryng. **52**:161 (March) 1943.

9. Ballenger, H. C.: The Local Use of Powdered Sulfathiazole in Acute Nasopharyngitis, Quart. Bull. Northwestern Univ. M. School **18**:109, 1944.

The patient was asked to refrain from blowing the nose for as long a period as possible. Many retained some of the sulfonamide powder in the nasal cavity and nasopharynx until the following morning despite ciliary activity. Visible evidence of the powder on the pharyngeal or the laryngeal mucosa was of short duration except as it continued to enter the nasopharynx and pharynx from the ciliary activity of the nasal mucous membrane.

RESULTS

An exact valuation of the clinical results is difficult, but when these results are compared with those in patients who did not receive insufflations of the sulfonamide compounds for one reason or another or with those in an equal number of patients with acute infections of the nose and throat who were treated by other means previous to the introduction of this method, the conclusion is inescapable that the course of the infection was shortened and the number of complications lessened. The sore throat and inflammation, especially that of the palate, nasopharynx and pharynx, were frequently stopped within twenty-four hours. However, the rhinitis and the cough would continue to develop in many patients, but not in as many as had been formerly observed. The numbers in whom sinusitis and the various forms of otitis developed were definitely lessened when compared with the numbers of patients not receiving this method of treatment in whom these complications appeared. The greatest value of the insufflation of the powdered sulfonamide compounds appeared to be in the first three or four days of the acute infection.

Goldman and Kiesewetter [10] reported that the average length of time spent in the hospital by military personnel with acute pharyngitis and tonsillitis was lessened by approximately one-fourth (controls, 4.4 days; treated persons, 3.3 days) after insufflations of sulfanilamide powder had been made two times daily. No evidence of sensitivity was found in their series.

This method of treatment seems to be of questionable value in the later stages of an acute infection. However, Williams [11] found that chronic nasopharyngitis responded to insufflations of sulfapyridine powder, especially in carriers of hemolytic streptococci.

SENSITIVITY

The objections advanced against this method of applying the various sulfonamide drugs to the nasopharyngeal mucous membranes are the same as those brought against the oral or parenteral use of these drugs,

10. Goldman, J. L., and Kiesewetter, W. B.: Treatment of Acute Pharyngeal Infections by Insufflation of Sulfanilamide Powder, Arch. Otolaryng. **43**:99 (Feb.) 1946.

11. Williams, H. L.: Chemotherapy in Otolaryngology, Wisconsin M. J. **44**: 507 (May) 1945.

but evidently to a much less degree. They are the possibility of general or local allergic reactions, dermatitis, blood dyscrasias, central nervous system reactions, renal or hepatic complications, hyperpyrexia, weakness, pallor, nausea and vomiting. The possibility of establishing sulfonamide-resistant organisms or sensitization should also be considered.

Seven persons out of the 1,500 treated gave evidence of sensitivity as manifested by a dermatitis, hives or hay fever–like symptoms. This was less than 0.5 per cent. In 1 patient a moderate fever developed with a local dermatitis on two occasions when sulfathiazole was used. The rash was localized around the nose or the face in most cases but was generalized in a few instances. The rash and the hives disappeared after from one to several days. No other complication was noted. No asthma developed, although most patients inhaled some of the powder. No patient with known sensitivity to the sulfonamide compounds was accepted for this method of treatment.

Sensitivity arising when sulfonamide compounds are locally applied to the mucosa of the respiratory tract seems to be less than that occurring when these drugs are taken by mouth and much less than that occurring when they are applied to the skin. Fink and Smith [12] reported sensitization of less than 1.4 per cent in 5,000 infants and children receiving sulfonamide compounds, chiefly sulfadiazine, by mouth. The reactions in the affected children were febrile, with a rash in 60 per cent. Seven of these children were given test doses of different sulfonamide drugs, and 2 reacted, but both received a third sulfonamide drug without evidence of toxicity. Coburn [13] found an incidence of sensitivity of 0.5 per cent in 600,000 Navy personnel who received sulfadiazine orally in prophylaxis of diseases of the respiratory tract. Mild dermal reactions occurred in 0.5 per cent and severe reactions in 0.01 per cent. Darke [14] reported an incidence of sensitivity of 5.5 per cent from the topical application of sulfathiazole cream in 218 cases of minor surgical treatment, a high incidence when compared with the 0.5 per cent incidence noted in this and other series.

Sulfonamide-resistant strains of bacteria have been reported as developing in the course of prolonged oral administration. Young and others [15] (Epidemiology Unit No. 22) reported that sulfadiazine-resistant strains were found after three months of successful sulfadiazine

12. Fink, H. W., and Smith, C. A.: Incidence of Reactions to Sulfonamide Drugs in Infants and Children, J. Pediat. **28**:40 (Jan.) 1946.

13. Coburn, A. F.: Mass Sulfadiazine Prophylaxis of Respiratory Diseases in the U. S. Navy, Bull. New York Acad. Med. **21**:281 (June) 1945.

14. Darke, R. A.: Sensitivity to Topical Applications of Sulfathiazole Ointment, J. A. M. A. **124**:403 (Feb. 12) 1944.

15. Young, D. C., and others: Sulfadiazine Resistant Strains of Beta Hemolytic Streptococci, J. A. M. A. **129**:921 (Dec. 1) 1945.

prophylaxis of infections of the respiratory tract at a large naval training center. The resistant strains of beta hemolytic streptococci were group A, type 19 and later type 17. Other types did not become resistant. No development of resistance was encountered in organisms in this series.

SUMMARY

Sulfathiazole, sulfanilamide and sulfadiazine powders, alone or in combinations, were applied by insufflation to the mucous membrane of the upper respiratory tracts of 1,500 persons suffering from various acute infections of the nose and throat (6,000 applications). Insufflation of these drugs proved to be as safe or safer than their oral use. An incidence of sensitivity of less than 0.5 per cent was found. The greatest usefulness is in the early stage of the infection.

25 East Washington Street.

RUBBER CATHETER USED TO MAINTAIN THE PATENCY OF THE OSTIUM IN DACRYOCYSTORHINOSTOMY

A Preliminary Report

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NEW YORK

THE TREATMENT of chronic dacryocystitis, associated with obstruction of the nasolacrimal duct and excess epiphora, has tempted the imagination of both ophthalmologists and rhinologists since the beginning of this century. The interest of men in both groups has been aroused because of the two possible approaches to the creation of a fistulous tract, the external and the intranasal.

In general, the ophthalmologists have favored the external, the rhinologists the intranasal approach. However, there have been a few noteworthy exceptions. The eminent otolaryngologist Mosher abandoned the intranasal technic and devised a modification of the Toti-external operation. On the other hand, Wiener and Alvis, in their book, "Surgery of the Eye," recommended the intranasal technic of Wiener and Sauer as the procedure of choice for dacryocystorhinostomy. This operation is a modification of the procedure devised by West, who was among the first to use the intranasal method.

The intranasal operation of West [1] consists in turning down a quadrilateral flap of nasal mucoperiosteum to expose the ascending process of the superior maxilla and the lacrimal bone and resecting a window in the ascending process and lacrimal bone and the nasal wall of the lacrimal sac. In the Wiener-Sauer [2] operation, the lacrimal bone is identified by means of a probe passed into the nose through the canaliculus and sac, the lacrimal bone is exposed by reflecting the mucoperiosteum and the lacrimal bone and nasal wall of the sac are removed intranasally.

The essential principle of the operation described by Toti [3] is the suturing of the corresponding edges of the longitudinal incisions of the

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* Formerly Colonel in the Medical Corps of the Army of the United States.

Presented as a candidate's thesis to the American Laryngological, Rhinological and Otological Society Inc.

1. West, J. M.: The Intranasal Lacrimal Sac Operation, Arch. Ophth. **55**: 351-361, 1926.

2. Wiener, M., and Alvis, B. Y.: Surgery of the Eye, Philadelphia, W. B. Saunders Company, 1940, p. 414.

(Footnotes continued on next page)

lacrimal sac and nasal mucosa after the external resection of the bony lacrimal gutter. In the Mosher[4] operation, the nasal wall of the lacrimal sac and the approximating nasal mucous membrane are removed, and then the edges are sutured.

Other operations which have been recommended for the reestablishment of a communication between the lacrimal sac and the nose have been based on these procedures except the one devised by Yankauer.[5] His operation attempts to reestablish the patency of the normal lacrimal system.

The success of any dacryocystorhinostomy depends on permanent patency of the created fistulous tract. Castroviejo,[6] who performs the external operation, has used a thread, passed through the inferior canaliculus into the nose, to help create a permanent fistulous opening.

The purpose of this paper is to make a preliminary report on a method devised to form and to maintain a permanent fistulous ostium between the lacrimal sac (or even the common fundus of both canaliculi when the sac is absent) and the nose. This method can be used both in the intranasal and in the external operations. It consists in passing a silk thread through the inferior canaliculus into the nose with the eye end of a straight needle, grasping the thread in the nose and suturing it to the end of a rubber catheter, and pulling the catheter through the created fistulous opening into the lacrimal sac or the fundus. The thread is then anchored on the forehead.

This method was used on 4 soldiers who had obstructed lacrimal systems. The first 3 patients were operated on by the intranasal approach and the fourth by the external approach. With 2 patients it was necessary to remove the catheter and thread on the seventh day because of a local inflammatory reaction in the region of the canaliculus and adjoining portion of the sac. With the other 2 patients the catheter was removed on the fourteenth day. No local reactions occurred in these patients, most likely because of the postoperative chemotherapy. One patient received sulfadiazine for eight days; the other, penicillin for the entire fourteen days. The 4 patients, after recovering from the dacryocystorhinostomy, returned to active and useful military duty.

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3. Toti, A.: Nuovo metodo conservatore di cura radicale delle suppurazione croniche del sacco lacrimale (Dacriocistorinostomia), Clin. mod. Pisa **10**:385-387, 1904; Sette anni di esperienza colla rinostomia del sacco lacrimale (Dacriocistorinostomia) nella cura delle dacriocistiti e delle fistole lacrimali, Bull. d. sc. med. d. Bologna **11**:692-694, 1911.

4. Mosher, H. P.: Reestablishing Intranasal Drainage of the Lacrimal Sac, Tr. Pacific Coast Oto.-Ophth. Soc., 1921, pp. 47-67.

5. Yankauer, S.: The Technic of Intra-Nasal Operations upon the Lacrimal Apparatus, Laryngscope **22**:1331, 1912.

6. Castroviejo, R.: Dacriocistorinostomia en los casos que previamente se extirpo el saco lagrimal, Am. clín. **3**:74-79, 1942.

INTRANASAL PROCEDURE

The procedure employed on the first 3 patients followed the intranasal operation suggested by Wiener and Sauer, modified by the insertion of the rubber catheter as I have described. I had the privilege of working with Lieut. Colonel Phillips Thygeson on these patients at Army Air Forces Regional Hospital, Drew Field, Fla., and to this study he contributed valuable suggestions and technical assistance. The operation, in brief, was as follows: The posterior portion of the lacrimal bone, which contained the lacrimal sac, was first localized by Colonel Thygeson by passing a Ziegler probe into the sac and through the lacrimal bone into the nose, always traversing a part of the anterior ethmoid labyrinth. In all instances, a portion of the anterior tip of the middle turbinate was removed,

Fig. 1.—Picture demonstrating the hemostat attached to the catheter in the nose and the black silk thread that was passed through the inferior canaliculus, attached to the forehead.

and the anterior ethmoid cells were exenterated. The lacrimal bone was removed with a small gouge and ethmoid punch forceps, which was followed by the removal of the adjoining thickened wall of the lacrimal sac. Punch forceps and a no. 11 Bard-Parker blade were used to accomplish this. A lacrimal syringe needle inserted into the sac was employed to considerable advantage as a guide to outline the limits of the sac. After the ostium was created, a black silk thread was passed through the inferior canaliculus into the nose. This thread was sutured to the end of a rubber catheter, no. 12 or 14, and then the catheter was pulled into the sac. To hold the catheter in position, the thread was attached to the forehead with adhesive tape. The bleeding was controlled at the time of operation in each instance, and packing was not used.

In each of the 3 cases in which the intranasal operation was performed it was necessary to do a submucous resection to obtain adequate

exposure of the lacrimal area. This preliminary procedure and the removal of the anterior tip of the middle turbinate and the adjacent anterior ethmoid cells permitted free access to the entire mesial half

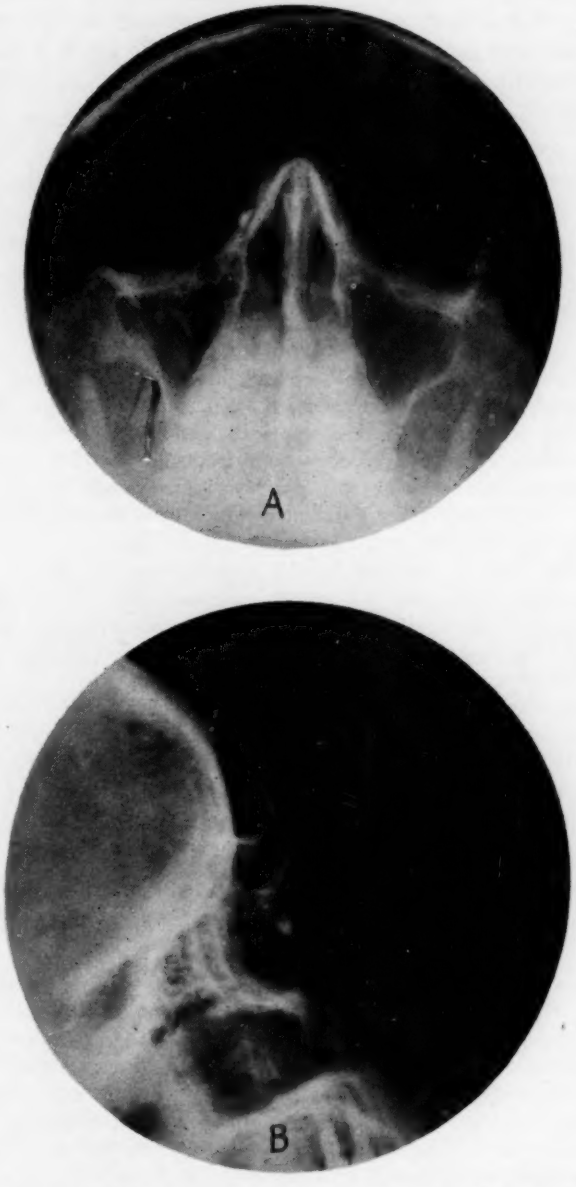


Fig. 2.—*A*, anteroposterior roentgenogram made after injection of iodized oil, demonstrating the superior and the inferior canaliculus and the common fundus. *B*, lateral roentgenogram made after injection of iodized oil, demonstrating the superior and the inferior canaliculus and the common fundus.

of the lacrimal sac. This also facilitated insertion of the rubber catheter and treatment of the areas operated on.

The fourth patient, who was operated on at William Beaumont General Hospital, presented an interesting problem because of a lack of development of the lacrimal system. The lacrimal structure consisted of nothing more than both canaliculi and a common fundus (fig. 2). Because of the absence of the sac, it was deemed best to use the external operation in this instance. The Toti-Mosher technic was employed except that the nasal mucous membrane and the sac were not sutured together. Instead, a no. 10 catheter was inserted into the fundus in the manner already described (fig. 1). In this case also a preliminary submucous resection was done, and as part of the operation it was necessary to remove the anterior tip of the middle turbinate and anterior ethmoid cells.

REPORT OF CASES

CASE 1.—A corporal 27 years old was admitted to the Eye Section, May 10, 1943, with complaint of a purulent secretion draining from the right eye. In June 1942 an abscess of the right lacrimal sac had developed which required incision. Purulent secretion had continued to appear from the inferior canaliculus, and intranasal dacryocystorhinostomy was performed one month later. The ostium closed after a short period; then purulent secretion once again began to discharge from the inferior canaliculus.

Examination revealed that the inferior canaliculus was slit and discharging purulent secretion. There was an external lacrimal fistula from which yellow-green mucopurulent material could be expressed. An irrigating solution or a probe could not be passed into the nose. Nasal examination revealed a high right deviation of the septum but no evidence of sinus infection.

The patient was transferred to the Ear, Nose and Throat Section, where submucous resection was done June 7, 1943. Intranasal dacryocystorhinostomy with removal of the anterior tip of the middle turbinate and anterior ethmoid cells was done on July 14. A no. 12 catheter was pulled into the sac. The catheter was removed on the seventh day because of a local inflammatory reaction. Four days later there was no evidence of lacrimal infection or tearing except when the patient lay on his right side. At the time of discharge, August 23, the intranasal area operated on had healed, the patient experienced no tearing and the ostium functioned well, as evidenced when merbromin, N. N. R., dropped into the eye quickly passed into the nose.

The patient was last seen by me on April 6, 1944. In the region of the lacrimal ostium there was a perforated web which bulged inward each time the patient closed his eye. Merbromin instilled into the eye appeared in the nose with each contraction of the muscles of the eye. According to the patient, tearing appeared only after nasal infections and in strong winds. The patient was last seen by Colonel Thygeson in September 1945, who has informed me that merbromin once again appeared quickly in the nose after being instilled into the eye and that the patient was still free from tearing except in heavy winds.

CASE 2.—A 22 year old corporal was seen in the Eye Clinic on Aug. 6, 1943. His complaint was constant tearing of the right eye with frequent formation of a film over the eye. This condition had existed for ten years following acute suppurative dacryocystitis which required incision.

On examination excess tears and mucopus were present in the inner canthus. An irrigating solution and a probe could not be passed into the nose. A stricture of the inferior canaliculus was noted. Nasal examination revealed a high right deviation of the septum and a moderately swollen right inferior turbinate.

The patient was admitted to the E. N. T. Section on August 12. A submucous resection was performed on August 16. Intranasal dacryocystorhinostomy, with removal of the anterior tip of the middle turbinate and a few anterior ethmoid cells, was performed on September 8. A no. 14 catheter was pulled into the sac. Sulfadiazine was administered postoperatively for eight days. There were no postoperative complaints and no local reaction. The catheter was removed on the fourteenth postoperative day. Merbromin dropped into the eye passed into the nose on the following day. A mild attack of conjunctivitis responded well to treatment. The patient was discharged to full duty on October 6. The intranasal area operated on had healed; merbromin dropped into the eye appeared quickly in the nose; saline solution passed through the inferior canaliculus into the nose readily. On November 13 it was noted that there was no infection in the lacrimal sac. The patient stated that there was about 75 per cent less tearing than prior to operation. It was believed that the presence of some excess tearing was due to the stricture which was present in the lower canaliculus and could be easily felt. Colonel Thygeson demonstrated that solution injected into the upper canaliculus passed into the nose quickly and readily, while solution injected into the lower canaliculus was delayed. A letter from the patient, dated Dec. 22, 1943, stated that there was no longer any discharge from the eye and that the tearing was bothersome only when the eye was exposed to cold weather.

CASE 3.—T/5, 29 years old, was seen in the Eye Clinic on Jan. 25, 1944. His complaint was excessive tearing of the left eye for two and a half years and presence of a film over this eye. Examination showed yellowish secretion and excessive tears in the inner canthus. Irrigating solution and probes could not be passed into the nose. Nasal examination revealed a slight left deviation of the septum.

The patient was admitted to the E.N.T. Section. Submucous resection was performed on February 7, and intranasal dacryocystorhinostomy on March 30. In this instance the lacrimal bone was covered with a large number of ethmoid cells and the anterior third of the middle turbinate, which were removed. A no. 12 catheter was pulled into the sac. On the seventh day the catheter was removed because of swelling and redness of the lids. On the second day after the removal of the catheter, the patient offered the information that the tearing had stopped. Mild conjunctivitis persisted for a month. The patient was discharged on May 8, with no evidence of tearing or infection. Merbromin dropped into the eye passed into the nose immediately. This same status was also noted on August 5.

CASE 4.—A corporal 31 years old was seen in the Eye Clinic, Jan. 27, 1945, because of excessive tearing of the left eye, from which he had suffered all his life. Examination of the eye showed an excessive amount of tears. It was impossible to pass a probe beyond the common fundus of both canaliculi. The frontal process of the left maxillary bone was not as fully formed as that of the right maxillary bone. A roentgenogram made after injection of iodized poppyseed oil 40 per cent showed that there was no lacrimal system beyond the common fundus and that we were dealing with congenital underdevelopment. Nasal examination revealed a high left deviation of the septum.

The patient was admitted to the E.N.T. Section on February 16. Submucous resection was performed on February 20. Dacryocystorhinostomy was delayed until May 24, because of an attack of scarlet fever. The anterior tip of the middle

turbinate was removed, and the anterior ethmoid cells were exenterated. The principles of the Toti-Mosher operation were followed except that the mucous membrane of the nose and the edges of the fundus were not sutured together. The entire mesial half of the fundus was excised. A no. 10 catheter was pulled into the fundus. Penicillin, 20,000 units, was given every three hours postoperatively. There were no postoperative complaints and no local reaction. The catheter was removed on the fourteenth day, and the administration of penicillin was stopped. A solution of fluorescein dropped into the eye two days later appeared in the nose within several seconds, and this solution injected into the inferior canaliculus passed into the nose immediately. The patient was discharged from the hospital on June 25, when it was noted that the intranasal area operated on had healed, that the

Fig. 3.—Picture demonstrating the silk thread attached to the rubber tube emerging through the skin above the upper canaliculus and below the mesial portion of the eyebrow.

newly formed ostium in the nose was visible and that a solution of fluorescein dropped into the eye appeared in the nose almost immediately. The latter observation was repeated on October 25, when the patient stated that he experienced about 85 per cent less tearing than prior to the operation.

COMMENT

The object of any dacryocystorhinostomy is to create an ostium between the lacrimal sac and the nose which will remain patent. All the operations devised for this purpose except the procedure suggested by Castroviejo have relied on surgical technic without any mechanical assistance for success. It has been my desire in this paper to make a preliminary report on a method devised to increase the possibility of establishing a permanent patent ostium. The method consists in

inserting a rubber catheter into the lacrimal sac or fundus and permitting healing of tissues to occur around this catheter. This mechanical device can be used in both the intranasal and the external operations. The catheter is held in place in the sac by a silk thread which has been passed through the inferior canaliculus and which is anchored onto the forehead with adhesive tape. The principle involved in this procedure is similar to that employed in maintaining the patency of the nasofrontal duct in external frontal sinusotomy.

This method was used in operating on 4 patients in the armed forces who had obstructed lacrimal systems. On 3 patients intranasal dacryocystorhinostomy (Wiener-Sauer) was performed, and on the fourth an external operation (Toti-Mosher). Tearing ceased and evidence of infection disappeared in each instance within several days after removal of the catheter. Although the number of cases in which the method was used is small and the patients have been observed for a short period of time, the results obtained were gratifying.[7]

7. The rubber catheter has been used to maintain the patency of the ostium established by dacryocystorhinostomy in 5 additional patients. In each instance, under the influence of penicillin, the rubber tube remained in situ for fourteen days without causing any significant local reaction. A submucous resection and some degree of anterior ethmoidectomy were also performed on each of these patients. The Toti-Mosher external approach was done in all 5 cases. All the patients presented deformities of the maxillary or the lacrimal bone or both. In 4 these deformities resulted from wounds from enemy action, and in 1, from an accident. At the time of the operation there was active suppuration in the sacs of all of these patients. With the first 4 patients the technic described in this article for anchoring of the silk thread was used. In 3 of these patients the silk thread cut through the canaliculus for about 2 mm. This had not occurred in the other cases reported in this paper. It is believed that this may have been due to the friability of the canaliculi caused by the presence of infection in the sacs. The canaliculi healed in 2 of the 3 patients. The infection cleared in 4 of 5, and in the fifth patient a small amount of thin secretion could be expressed into the nose through the ostium at the time of discharge. About 70 per cent diminution of tearing was obtained in this case. In another patient there was also about 70 per cent diminution, and in the remaining patients there was no tearing at the time of discharge from the hospital. One of these patients had the persistent split canaliculus. These patients were operated on with the cooperation of Major George A. Filmer and were followed for a short period. Because of the cutting effect of the silk on the canaliculi in the presence of infection in the external operation, the procedure for anchoring the silk thread was changed in the fifth case, following a suggestion made by Major Filmer. The silk thread, attached to the end of the catheter, was brought through the vault of the sac just above the orifice of the upper canaliculus and through the skin under the mesial portion of the eyebrow. The thread was then anchored to the forehead in the usual fashion. Protection of the underlying skin was afforded by passing the thread through a rubber tube (fig. 3). At the time of discharge from the hospital, tearing had ceased in this case. All these patients were operated on at William Beaumont General Hospital.

The patients were observed for the following periods: two years and two months, three months, four months and five months. Direct contact was lost with the first 3 patients because of transfers to other installations. However, the patients were advised to write to me if evidence of closing of the ostium occurred and such information has not been received. I am aware of the inadequacy of such a method of following patients.

In the 2 patients who did not receive postoperative chemotherapy there occurred a local reaction of edema and redness involving the lids and the area of the lacrimal sac, undoubtedly due to the presence of the catheter in the sac and the thread in the canaliculus. No such reaction was observed in a patient who received sulfadiazine and in another who received penicillin. In both of these patients it was possible to permit the catheter to remain in place for fourteen days. It is believed that penicillin is the drug of choice for this purpose.

The questions of performing a preliminary submucous resection, removing the anterior tip of the middle turbinate and exenterating the anterior ethmoid cells have invited different expressions of opinion. My limited experience seems to indicate that all these procedures, particularly the last two, greatly enhance the chances of success of the operation. If the nasal septum encroaches on the lacrimal area to the slightest degree, a preliminary submucous resection will most likely prove to be helpful.

It should be evident that there is need for cooperation between the rhinologist and the ophthalmologist in both the intranasal and the external dacryocystorhinostomies. I, a rhinologist, was fortunate in having the help of two able ophthalmologists—Colonel Thygeson with the first 3 patients and Major Filmer with the fourth.

SUMMARY

This is a preliminary report on a method to increase the chances of establishing a permanent ostium in dacryocystorhinostomy, intranasal or external.

The method consists in anchoring a rubber catheter in the lacrimal sac or the fundus to a silk thread which had been passed through the inferior canaliculus.

Four patients in the armed forces were treated for obstruction of the lacrimal system by this method. Intranasal dacryocystorhinostomy (Wiener-Sauer) was performed on 3, external dacryocystorhinostomy (Toti-Mosher) on the fourth. Satisfactory results were obtained in all.

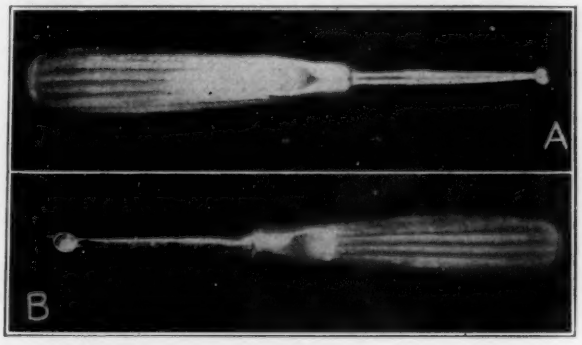
1050 Park Avenue.

Clinical Notes; New Instruments and Technics

A USEFUL PERIOSTEAL ELEVATOR

WILLIAM LAWRENCE GATEWOOD, M.D., NEW YORK

THIS instrument was designed as a substitute for the Joseph's periosteal elevator commonly used in nasal plastic repair. It is so constructed that it will freely lift the periosteum from the underlying bone with a minimum of effort on the part of the surgeon. It is small and of simple design and can be used in all types of work requiring elevation of the periosteum. It has been found particularly useful in nasal plastic procedures, in submucous resection of the nasal septum and in surgical treatment of the mastoid process and nasal sinuses.



Periosteal elevator: *A*, outer surface; *B*, inner surface.

On superficial inspection the instrument has the appearance of a mastoidectomy curet. The difference, however, is that the shank of the elevator is flat on one side and the spoon has a shallow cupping. The instrument is unique. When it is introduced under the bone covering there is no shredding or tearing of this structure. Elevation is easily and rapidly accomplished because separation takes place on both the push and the draw movement.

AEROSOL PENICILLIN ADMINISTERED IN PARANASAL SINUSITIS WITH BALANCED SUCTION AND PRESSURE

GERVAIS W. McAULIFFE, M.D., and GEORGE C. MUELLER, M.D., NEW YORK

PENICILLIN has become an antibiotic substance most widely used for the control of local or general infection. This popularity has been achieved because of its comparative lack of toxicity and its superlative performance.

It has been reported that penicillin is effective in the treatment of acute and chronic infections of the paranasal sinuses when given in solution by the intra-

From the Department of Surgery of the New York Hospital and Cornell Medical College Association.

muscular route and when inhaled in the form of penicillin aerosol. An apparatus is described in this paper that replaces the air content of the paranasal sinuses with penicillin mist by the use of balanced suction and pressure.

Nebulization of various drugs has been practiced for many years and more intensively in the field of otolaryngology than in that of any other branch of medicine. Shortly after the discovery of the therapeutic use of penicillin, attempts at nebulization and studies of the effect of the nebulized substance on infection were started. Bryson, Sansome and Laskin [1] first described aerosolization in July 1944, and in April 1945 Barach and his co-workers [2] submitted a comprehensive analysis based on a study of 200 cases.

As a result of these investigations by Bryson and his co-workers, of the Cold Spring Harbor Laboratory, the following principles were determined:

1. Simple commercial nebulizers of the DeVilbiss no. 40 type can be used to nebulize solutions of penicillin even when the concentration of the substance is as high as 200,000 units per cubic centimeter.

2. The potency of penicillin is not reduced by the air flowing through the nebulizer. Oxygen similarly has no deleterious effect.

3. Aerosol penicillin penetrates into the lungs.

4. The penicillin of the aerosols diffuses into the blood stream and can be recovered from the urine.

5. Appreciable amounts of penicillin are absorbed through the lungs.

6. Penicillin mists of concentrations much higher than those required for therapeutic efficacy can be safely inhaled by man.

Barach [3] and his co-workers, at the Presbyterian Hospital, New York, were the first to apply these principles in the treatment of acute and chronic infections of the paranasal sinuses.

Through the kindness of Dr. Alvan Barach we had the opportunity to use two of his original apparatus at our office and at the New York Hospital for the treatment of infections of the upper respiratory tract and paranasal sinuses. From time to time during the past two years several modifications have been made by Dr. Barach to simplify the application of this type of treatment.

Using Dr. Barach's apparatus and its modifications as a model, we applied the same principles in developing the wet suction instrument.[4]

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1. Bryson, V.; Sansome, E., and Laskin, L.: Aerosolization of Penicillin Solutions, Science **100**:33 (July 14) 1944.

2. Barach, A. L.; Silberstein, F. H.; Oppenheimer, E. T.; Hunter, T., and Saroka, M.: Inhalation of Penicillin Aerosol in Patients with Bronchial Asthma, Chronic Bronchitis, Bronchiectasis and Lung Abscess: Preliminary Report, Ann. Int. Med. **22**:485 (April) 1945.

3. Hufferd, R. W.: Penicillin Aerosol: Contribution of the Chemical Warfare Service to Medicine, Science **104**:498 (Nov. 29) 1946.

4. Barach, A. L.; Garthwaite, B.; Soroka, M., and Anderson, F. F.: An Apparatus for the Introduction of Penicillin Aerosol into the Nasal Accessory Sinuses, with a Case Report of a Patient with Chronic Sinusitis, Ann. Int. Med. **24**:97 (Jan.) 1946. McAuliffe, G. W.: Wet Suction of the Tonsil, Eye, Ear, Nose & Throat Monthly **10**:325 (Sept.) 1931; A Wet Suction Unit for the Ear, Nose and Throat, ibid. **11**:230 (July) 1932.

The use of this apparatus is relatively simple. It is a small, compact, portable unit which can be used with any standard vacuum and pressure pump. Any standard type of aerosol nebulizer can be utilized.

Once the pressure is connected to *A* as illustrated in figure 1, a back pressure is built up by virtue of the restriction in the nebulizer (*J*). This pressure is automatically released at 10 pounds (4.5 Kg.) of pressure by the relief valve (*C*). The gage (*K*) registers the degree of pressure. Any pressure below or above 10 pounds can be obtained by adjusting the regulating screw (*G*).

When the vacuum is connected to *B* and the nose piece (*M*) a vacuum is built up and is released at 7 inches mercury by the vacuum relief valve (*D*). A gage

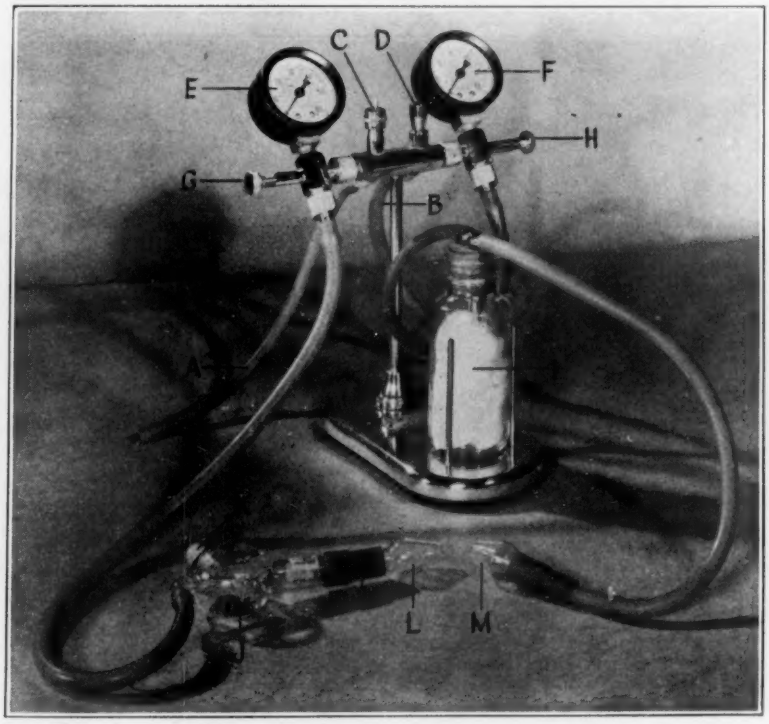

Fig. 1.—The apparatus: *A* indicates connection to pressure of pump; *B*, connection to vacuum of pump; *C*, pressure relief valve set for 10 pounds' pressure; *D*, vacuum relief valve set for 7 inches of mercury vacuum; *E*, pressure gage; *F*, vacuum gage; *G*, pressure regulation screw; *H*, vacuum regulation screw; *I*, overflow and moisture vapor trap; *J*, aerosol nebulizer; *K*, stopper of nebulizer; *L* and *M*, glass nose pieces.

(*F*) registers the degree of the vacuum, and adjustment of the regulating screw (*H*) allows regulation below or above 7 inches of mercury. Thus both suction and pressure can be accurately calibrated and balanced. The bottle (*I*) interrupts the vacuum line and acts as a trap to collect any secretions from the nose. The cotton and gauze in the bottle also serve to collect any condensed moisture particles and so prevent their entering the pump proper.

We have found that suction or vacuum at 7 inches mercury should be balanced with 10 pounds of pressure to cause the least discomfort to the patient and to obtain the best results.

The apparatus is used in the following manner: The stopper (*K*) is removed to instil the solution of penicillin into the nebulizer, and the orifice is then used as a finger control to close the suction gap as illustrated in figure 2. The nose pieces (*L*) and (*M*) are then placed in the two nares. The soft palate is raised by having the patient say "Kay, Kay, Kay." At the same time the suction gap is closed by placing the finger over the orifice in the nebulizer at *K*, and the vacuum is rapidly built up as indicated on the vacuum gage. This creates vacuum rapidly and exhausts the air in the paranasal sinuses while concentrated penicillin mist is

Fig. 2.—Patient using the apparatus.

being delivered from the nebulizer, propelled by 10 pounds of pressure, through the left nasal chamber and out through the right nasal chamber. The finger is then removed from the control orifice at *K*, thereby releasing the vacuum. When the vacuum is released, the concentrated penicillin mist replaces the air content of the paranasal sinuses which had been removed by the vacuum. This procedure is then repeated the desired number of times for an interval of three minutes.

The apparatus can also be used for inhalation by employing the pressure unit only or by alternately using the vacuum unit as described and then inhaling through both nose pieces while in the same position and exhaling through the open mouth.

Any aqueous or oil base medication, as well as penicillin, can be used with this apparatus in the manner which has been described.

SUMMARY

An apparatus has been described to replace the air content of the paranasal sinuses with penicillin aerosol by using balanced calibrated suction and pressure. We have used the apparatus at our office and at the New York Hospital in the treatment of acute infections of the upper respiratory tract and infections of the paranasal sinuses with uniformly good results during the past six months. We have found it to be desirable because it is small, compact, accurate and tolerated with the minimum of discomfort by the patient. This apparatus can be used with any standard vacuum or pressure pump.

CONCLUSIONS

1. Research conducted by a number of investigators has demonstrated conclusively the presence of penicillin in the blood stream and the urine after the application of aerosol penicillin.

2. Aerosol penicillin is a safe, rational, effective mode of treatment for acute infections of the upper respiratory tract and infections of the paranasal sinuses.

3. Only rarely is the type of treatment contraindicated (i. e., when a definite allergy to penicillin is present).

4. We have found this apparatus to be effective, simple to operate and portable. The application of this type of treatment has thereby been simplified.

The apparatus was developed and manufactured by Mr. Charles M. Sorensen of the C. M. Sorenson Company, Inc., New York.

630 Park Avenue (Dr. McAuliffe).

LOCAL USE OF PENICILLIN IN ALCOHOL AND GLYCERIN FOR CHRONICALLY RUNNING EARS

AUBREY G. RAWLINS, M.D., SAN FRANCISCO

THE local use of aqueous solutions of penicillin in cases of nonoperative chronic discharge of the ear is disappointing.

Since there is practically always a secondary staphylococcic infection of the ear in these cases, penicillin should be the most effective drug.

It was concluded, therefore, that the aqueous diluent must be at fault. After a consultation with pharmacologists, it was decided to use penicillin in a solution of equal parts of 70 per cent alcohol and saturated glycerin; this would be 35 per cent alcohol and 50 per cent glycerin. Usually 1,000 units of penicillin per cubic centimeter is added to the alcohol-glycerin solvent.

This diluent has the following advantages:

1. It does not harm the action of the penicillin.
2. It is dehydrating.
3. It shrinks rather than swells any cholesteatomatous material.
4. It tends to stick well and hence keeps the penicillin in contact with the infected area almost continuously. (This is very important.)

The following method of treatment is recommended in these cases:

1. With the patient in the office, thoroughly cleanse the ear with 70 per cent alcohol (usually with applicators).

2. With the head resting on the good side, fill the aural canal full of the penicillin-alcohol-glycerin solution and let it soak for twenty minutes. Insert cotton in the canal.
3. At bedtime have the patient cleanse the ear with 70 per cent alcohol and then fill the canal with the penicillin-alcohol-glycerin solution and insert cotton in the canal. Have the patient try to sleep on the other side if possible.
4. Have the patient fill the canal full of solution in the morning and then reinsert the cotton in the canal.
5. Have the patient do this for two weeks and then stop treatment for one week and return for observation.

At this time there is a good chance that the ear will be dry. If it is not, repeat the treatment once or twice more.

In my hands this treatment has been by far the most effective local therapy which I have ever used in nonoperative chronically running ears. The results are far superior to those obtained by use of an iodine–boric acid dusting powder or powdered sulfonamide compounds or by any other usual method.

I am sure that any one who will try this treatment will be greatly pleased with the high percentage of dry ears that result.[1]

384 Post Street.

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1. Since submitting this article for publication I have modified this therapy slightly in cases in which the aural condition was resistant. The patient uses the penicillin-alcohol-glycerin solution for one week and then switches to glycerite of hydrogen peroxide for one week, using the latter in the same manner as described for the penicillin solution. This appears to be more effective in such cases.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

TUBERCULOSIS

GEORGE E. WILSON, M.D.
AND
WILLIAM K. STERN, M.D. *
SARANAC LAKE, N. Y.

THIS collection of abstracts is a continuation of our previous literary survey [1] and supplements it by adding abstracts of articles which were not available during the war. There still is a remnant of articles not yet obtainable and the titles of these are listed in a supplementary bibliography at the end.

One of the outstanding publications in the field of tuberculosis of the upper respiratory tract is Myerson's [2] book. It is a welcome and essential monograph, combining vast clinical experience with an extensive knowledge of the literature; it is imperative reading for any one interested in this particular branch of medicine.

We would also call attention to the works of Zoellner,[3] Brüggemann,[4] Randerath [5] and Rickmann,[6] who give an elaborate and scholarly treatise on otorhinolaryngologic tuberculosis, which might be somewhat dated in the light of the latest therapeutic achievements, but is still extremely valuable for any one engaged in literary research.

We are greatly indebted to Spencer,[7] whose yearly surveys have helped us to complete our own series of abstracts.

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* Fellow of the Trudeau Foundation.

1. Wilson, G. E., and Stern, W. K.: Survey of the Literature on Tuberculosis, Arch. Otolaryng. **41**:335-371 (May); 442-458 (June) 1945.

2. Myerson, M. C.: Tuberculosis of the Ear, Nose and Throat, Springfield, Ill., Charles C Thomas, Publisher, 1944.

3. Zoellner, F.: Tuberculosis of the Nose and Pharynx, Ergebn. d. ges. Tuberk.-Forsch. **9**:69-108, 1939.

4. Brüggemann, A.: Tuberculosis of the Ear, Ergebn. d. ges. Tuberk.-Forsch. **9**:109-142, 1939.

5. Randerath, E.: Pathological Anatomy of Laryngeal Tuberculosis, Ergebn. d. ges. Tuberk.-Forsch. **9**:143-190, 1939.

6. Rickmann, L.: Clinical Aspects of Laryngeal Tuberculosis, Ergebn. d. ges. Tuberk.-Forsch. **9**:191-250, 1939.

7. Spencer, F. R.: A Review of Tuberculosis, Laryngoscope **55**:1-15 (Jan.) 1945; A Review of Tuberculosis in the Field of Otolaryngology for Late 1944 and Early 1945, ibid. **55**:673-677 (Dec.) 1945.

Streptomycin, which seems to hold great promise and is drawing a lot of attention and high expectations from both physicians and the public, is being tested on a large clinical scale. However, the preliminary reports do not yet warrant definite evaluation of the drug in regard to its effects on otorhinolaryngologic tuberculosis.

GENERAL SURVEYS

Schmidt [8] discusses the problems of the otorhinolaryngologic differential diagnosis of syphilis, tuberculosis and cancer and the syndromes resulting from their occasional coexistence. Four cases are described, and a discussion of the literature is added. The diagnostic aids are given, e. g., radiology, biopsy, hematology, and systemic, pulmonary and laryngeal examinations. Occasionally, success or failure of treatment permits a diagnosis *ex juvantibus*.

Fernández Ponjoan [9] submits his experiences drawn from the examination of 1,000 patients with tuberculosis of the upper respiratory tract, 988 of whom (99 per cent) had tuberculous laryngitis, 91 (0.9 per cent) involvement of the pharynx and 5 tuberculosis of the nose. The text and two tabulations arrange the material according to sex, race, age, type and localization of the tuberculous lesions and the general condition of the patient. The author summarizes his observations as follows:

1. Tuberculosis of the nose is extremely rare.

2. Tuberculous lesions of the pharynx are predominantly found in the white race. Tuberculous involvement of the pharynx shows inclination toward the juvenile group, while tuberculous laryngitis seems to occur more frequently in the middle age group.

3. Pharyngeal lesions ulcerate faster than laryngeal ones, while these, on the average, have a comparatively better tendency toward healing.

4. The pharyngeal lesions show a preference for the posterior part of the oropharynx, while the hypopharynx is only rarely involved.

5. Tuberculous involvement of the larynx manifests itself more frequently as infiltration; that of the pharynx, as ulceration.

6. Tuberculous lesions of the posterior half of the larynx, the arytenoids and the interarytenoidal space are more frequently encountered in women and as infiltrations, while lesions of the vocal cords, the epiglottis, the ventricular bands and the aryepiglottic folds are met more frequently in men and tend toward ulceration with the possible exception of tuberculous chondritis; generally speaking, the author found a higher tendency toward infiltration in women and toward ulceration in men; this gave his female patients a relatively better prognosis.

7. The highest percentage of infiltration is derived from lesions of the vocal cords, while most of the ulceration is found in involvement of the epiglottis.

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8. Schmidt, W.: Diagnostic Difficulties in Coexisting Lues, Tuberculosis and Malignant Tumors in Otorhinolaryngology, Hals-, Nasen- u. Ohrenarzt (pt. 1) **31**:375-386 (June) 1941.

9. Fernández Ponjoan, E.: Practical Considerations from the Study of One Thousand Patients with Tuberculosis of the Upper Respiratory Tract, Vida nueva **51**:146-154 (April) 1943.

8. Lesions of the epiglottis and the aryepiglottic folds show the lowest standards as far as general condition is concerned. This is in contrast to the lesions of the vocal cords and the posterior half, which show comparatively better resistance.

Da Silveira [10] studied the case material of the San Sebastian Sanatorium of Rio de Janeiro, Brazil, and found that 60.5 per cent of his tuberculous patients showed secondary tuberculous laryngitis. His discussion of the morbid anatomy, the etiologic factors, the diagnosis and the prognosis is traditional and a repetition of a frequently described clinical syndrome.

In the paragraph concerning the treatment, the use of chaulmoogra oil is emphasized because, besides its anesthetic qualities, it promotes epithelization and cicatrization. Some patients seem to benefit from the use of large doses of vitamin A. The rest of the paper is devoted to a discussion of tuberculosis of the other organs of the upper respiratory tract. Tonsillectomy is advocated if there is evidence of primary tuberculosis of the tonsils. Primary tuberculosis of the ears is a not infrequent disease of early infancy, the specific nature of which is still too often overlooked by pediatricians.

Santeliz [11] presents a survey of tuberculosis of the upper respiratory tract encountered in Barquisimeto, Venezuela, which comprises 25 cases of tuberculous laryngitis, 11 of tuberculosis of the cervical lymph nodes, 2 of tuberculous otitis media, 1 of tuberculosis of the tonsils and 1 of tuberculous ulcers of the pharynx. The conclusions drawn from his clinical observations are traditional.

Ide's [12] paper is a reprint of a lecture on peroral endoscopy, evidently given during a hospital staff conference. After briefly sketching the importance and the technic of bronchoscopy, he gives 6 case histories in detail, 3 of which are of interest to the phthisiologist: a case of chronic tuberculosis of the larynx, a case of chronic tuberculosis of the bronchus and a case of pulmonary tuberculosis in which the disease was diagnosed by examination of a smear of the bronchial discharge. This lecture emphasizes the significance of bronchoscopy as a diagnostic aid and is of interest mainly to the general practitioner, having little to offer the otolaryngologist and the endoscopist.

Schwartz [13] gives an excellent and objective discussion of the effect of smoking in cases of tuberculosis, a subject which is frequently treated too vaguely and summarily. His survey is based on a questionnaire sent to about 50 directors of sanatoriums asking them whether they

10. da Silveira, A. G.: Tuberculosis of the Upper Respiratory Tract, Rev. brasil. de tuberc. **12**: (March-April) 1944.

11. Santeliz, P. A.: Some Considerations on Otorhinolaryngological Tuberculosis in Barquisimeto, Rev. san. y asist. social. **9**:1419-1430 (Dec.) 1944.

12. Ide, D.: Peroral Endoscopy: Its Aid to Clinical Diagnosis, New York State J. Med. **45**:1551-1554 (July 15) 1945.

13. Schwartz, H. F.: Smoking and Tuberculosis, New York State J. Med. **45**:1539-1542 (July 15) 1945.

consider smoking harmful to tuberculous patients, whether they prohibit it, what rules they employ to prevent smoking and what arguments they use to discourage it. The answers were summarized as follows: Twenty-six per cent considered smoking definitely harmful; 72 per cent, harmful if in excess, and 2 per cent, not harmful. Thirty-two per cent allowed it on recommendation of a physician and 40 per cent permitted it without approval; the remaining 12 per cent had no restrictions. Eighteen per cent tried to advise the patient about smoking; 40 per cent restricted it to certain places at limited hours; 14 per cent forbade it completely on threat of discharge, and 22 per cent had rules but lacked enforcement; 6 per cent had no rules. Among the arguments used to discourage the patient from smoking, 16 per cent said that it was detrimental to health and appetite; 62 per cent, that it was irritating to bronchi and larynx; 8 per cent, that it constituted a fire hazard; 14 per cent used no argument at all.

The author emphasizes the fact that while more than 95 per cent of the physicians feel that smoking is more or less detrimental to the health of their patients, less than 20 per cent took any drastic steps to prevent it. The second part of the paper discusses the physiologic effects of nicotine, and the discussion is substantiated by numerous literary references. Certain factors are taken into consideration, such as inhalation, the type of tobacco used, the number of cigarets consumed daily, the speed of smoking, the length of cigarets, the use of filters and the surroundings. The general effects on metabolism, the circulation, and the gastrointestinal, nervous and respiratory systems are described in detail. Most authors agree that locally tobacco has an irritating and injurious effect on the mucosa of the respiratory tract, which shows extensive deposits of tar and tar products at necropsy. Clinicians find that smokers have more colds and sinus trouble and that these last longer than those of the nonsmoker, and the "cigaret cough" and the chronic pharyngitis of smokers are common knowledge.

At about the same time as the previous article was published, *The Journal of the American Medical Association* [14] commented on smoking in connection with pulmonary tuberculosis in its question box. The editors paraphrased the current attitude compactly and are hereby quoted:

> Statistical studies have not shown tuberculous infection or disease to be more frequent in users of tobacco than in those who abstain. Well controlled quantitative studies of the effect of tobacco on the course of pulmonary tuberculosis are lacking. Among tuberculous patients it has been found that those who smoke are apt to have a higher incidence of laryngeal involvement and that such complications appear to be adversely affected by persistence in smoking. Acceleration of the pulse rate, frequent extrasystoles and accentuated sinus arrhythmia, hacking cough, hoarseness and diminished appetite, which so often result from tobacco smoking, may simulate or even accentuate the symptoms of tuberculosis, whether

14. Smoking in Pulmonary Tuberculosis, Queries and Minor Notes, J. A. M. A. **128**:1132 (Aug. 11) 1945.

or not they exert much influence on the actual course of the disease in the average patient. The course of pulmonary tuberculosis is so variable and is influenced by so many factors that it is not easy to demonstrate an important or clearcut effect from any one item or detail in the regimen of treatment. Most phthisiologists, however, are convinced that smoking can do no good and may do harm sufficiently often to advise against it.

TUBERCULOSIS OF THE EARS

Richter [15] discusses the problem of undiagnosed pulmonary tuberculosis in otologic practice. The following syndromes should direct the attention of the otologist to the possibility of an active systemic tuberculosis heretofore undiscovered: a fetid auricular discharge without cholesteatoma; painlessly developing auricular suppuration; impairment of hearing without signs of involvement of the labyrinth; multiple central perforations of the tympanic membrane; rough, carious bone formation; deficient or delayed healing of operative wounds; persistent subfebrile temperature after purulent otitis media. The importance of postoperative histologic examination of any granulation or polypoid tissue is stressed.

According to Coté,[16] tuberculosis of the ear is more frequent than the clinical statistical compilations imply. Routine inoculations and cultures of auricular discharges have shown that chronic otorrhea is of tuberculous origin in between 10 and 20 per cent of the cases. One of the reasons for the present diagnostic shortcomings may be the fact that many leading textbooks describe tuberculous disease of the ear rather sketchily.

Pathogenesis.—With exception of a few rare primary forms, tuberculous otitis media is secondary in the vast majority of cases. Involvement of the middle ear in systemic tuberculosis might occur through the eustachian tubes, through the blood stream or through the lymphatic channels. The tubal route seems to be the most frequent in patients with pulmonary tuberculosis whose sputum shows the bacilli, especially old patients with chronic tuberculosis. The mucosal surface of the middle ear is as a rule resistant to the invasion of Koch bacilli, and it presumably requires massive bacillary invasion over a long period and a general anergic reaction of the patient to make implantation possible.

Hematogenous spread is much more exceptional but should be accepted in cases in which the sputum is persistently negative for tubercle bacilli and even more so in patients without specific pulmonary lesions. Osseous lesions probably develop this way, e. g., tuberculosis of the spongiosa of the temporal bone and mastoid process.

15. Richter, H.: On Accidentally Discovered Pulmonary Tuberculosis in Otological Practice, München. med. Wchnschr. **88**:831-835 (July 25) 1941.

16. Coté, G. L.: Considerations on Tuberculosis of the Ear, Union méd. du Canada **73**:129-134 (Feb.) 1944.

The lymphatic route seems the least explored, perhaps because knowledge of the anatomy of the lymphatic channels of the middle ear is limited. However, it may be safe to assume that the tuberculous otitis media of children with coexisting cervical adenitis might be lymphogenous. Analogous relations probably exist between tuberculosis of the adenoids and tonsils, on one side, and tuberculosis of the middle ear, on the other.

Anatomoclinical Forms.—Clinging to his etiologic classification, Coté first discusses the form due to tubal spread, characterized by insidious, painless onset, usually normal temperature and progressive deafness either of labyrinthine or of transmission type (otospongiosis). The tuberculous process might advance slowly, eventually invade the petrous pyramid and reproduce the syndrome of cochleovestibular labyrinthitis; usually humming and vertigo are absent. Otoscopic examination might reveal miliary tubercles, multiple perforations and white caries of the petrous bone. None of these findings is frequent enough to be reliable. The course of the disease might be disguised as the banal chronic otitis media. More often than not the tuberculous process does not destroy the bone structure; therefore osseous necrosis and mastoiditis are exceptional. The perforation of the tympanic membrane may close and scar, and the auditory function might be restored. On the other hand, confluence of perforations might lead to permanent deafness. In the rare cases of osseous necrosis the facial nerve might become affected and paralyzed, Gradenigo's syndrome might develop, typical labyrinthitis may be encountered, and even ulcers eroding the internal carotid artery have been reported in the literature with fulminant hemorrhages of the ear, which might terminate fatally if not stopped promptly by surgical intervention.

The prototype of the hematogenous infection is tuberculous mastoiditis, a rather rare clinical finding which is usually associated with other osseous or articular foci of tuberculosis.

The lymphogenous type, as mentioned, is tuberculous otitis in children, which might develop during the course of an acute rhinopharyngeal infection or grip. Its onset might simulate the common acute otitis, with elevation of temperature, pain and spontaneous perforation of the tympanic membrane, but, the chronic otorrhea which does not respond to the traditional therapy, together with the formation of granulations and fungosities, should guide one's attention toward the correct diagnosis, which can easily be substantiated by inoculating biopsy material into guinea pigs. The possibility of secondary tuberculous mastoiditis or even meningitis should always be kept in mind. Tuberculous otitis media might be preceded by the common pyogenous infection of the middle ear, which might camouflage it, especially if the latter has a tendency to recur.

Bertrand, Fuks and Levit [17] discuss tuberculous otomastoiditis, which occurs under three forms:

(1) as a localization of tubercle bacilli disseminated from a distant tuberculous focus by the blood stream.

(2) as a primary infection of a patient hitherto free from tuberculosis; in this event the mastoiditis presents the characteristics of a primary complex with the bacilli probably invading originally by way of the adenoid and pharyngeal tissues and spreading through the lymphatic systems to the ear and regional lymph nodes.

(3) as nontuberculous pyogenic mastoiditis coexisting with primary pulmonary tuberculosis.

In cases of far advanced pulmonary tuberculosis there are sometimes tuberculous lesions involving the acoustic nerve or the labyrinth, producing bilateral neuritis or serous labyrinthitis. The theory most frequently accepted as to the way of infection in tuberculosis of the middle ear is that of hematogenous dissemination, particularly in view of the fact that the regional lymph nodes are often not affected. This type of spread rarely occurs and is mainly of academic interest.

The authors report the case of a 2 year old child who, after showing a negative Mantoux test, was found, six months later, to have acute mastoiditis with cervical adenopathy. Mastoidectomy was performed, and the bone tissue was found to be friable and filled with little purulent secretion. The pus when inoculated into a guinea pig produced tuberculous lesions. Roentgenograms of the chest revealed no evidence of tuberculosis. After institution of gold therapy the patient improved, with gradual healing of the lesions and regression of the adenopathy.

Aleman [18] publishes the case history of a 3 year old child with bilateral pulmonary tuberculosis, tuberculous otomastoiditis and peripheral facial paralysis (Bell's palsy, or neuropathy of the facial nerve). Roentgenographic studies revealed hematogenous infection disseminated throughout both lungs and suppuration of the right mastoid process with destruction of the intercellular septums. The child died of tuberculous meningitis. There is a general discussion of tuberculous otomastoiditis and facial paralysis, with literary references.

We have to quote the following abstract literally from the *Tuberculosis Index* (London) because the original article was not obtainable through any of our libraries.

17. Bertrand, J. C.; Fuks, D., and Levit, M.: Tuberculous Otomastoiditis (Primary Infection), Arch. argent. de pediat. **23**:196-201 (March) 1945.

18. Aleman, E.: Prosoplegia in a Child with Pulmonary Tuberculosis and Otomastoiditis, Bol. Soc. cubana de pediat. **17**:216-226 (June) 1945.

Rubin [19] concludes from a review of the literature that so far no reliable characteristics have been ascertained on which to base this diagnosis. A new method is outlined consisting in aspiration of secretion from the middle ear cavity through the drum for bacteriological examination, and two cases are reported in which a total of 3 punctures yielded positive results.

Cooper and Latorre Aguero [20] report 3 cases of tuberculosis of the temporal bone with extensive sequestration. Tuberculous otomastoiditis is in most cases a disease of infancy and usually occurs in children with pulmonary tuberculosis, which presents the decisive prognostic factor. Surgical intervention is beneficial but has to be properly timed to avoid the risk of a fatal hematogenous dissemination.

The cardinal symptom of tuberculous otitis media is a fetid and abundant otorrhea which does not respond to the common methods of treatment. Eventually the facial nerve may become affected. Unless an early diagnosis secures a well timed surgical attack on the tuberculous focus, sequestration of various form and extension might set in, involving either the cortex of the mastoid process or part of the squamotemporal bone or the labyrinth itself or a considerable part of the petrous bone. The formation of these sequestrums is caused by the progressive thrombosis of the feeding vessels of the affected part and is an expression of the defensive reaction of the organism which seeks to isolate the focus of suppuration, a process which demands considerable lapse of time.

Naturally the roentgenogram is a diagnostic aid of first importance and an excellent guide for the timing of surgical intervention. The moment to operate depends primarily on the general condition of the child, permitting either a radical mastoidectomy or the removal of the sequestrum, which demands great delicacy and skill on the part of the surgeon to avoid a rightly feared hemorrhage of the internal carotid artery or of the internal jugular vein. After elimination of the sequestrum the purulent otorrhea decreases and finally disappears; during cicatrization of the focus the general status of the child improves readily. After healing the hearing might be decreased or abolished, depending on whether or not the petrous bone was affected. Temporary or permanent vestibular symptoms might remain, according to the extent of the involvement of the labyrinth.

TUBERCULOSIS OF THE NOSE

Tavani [21] discusses the diagnostic problems of tuberculosis of the nose and illustrates the subject with three observations of his own: the first

19. Rubin, H.: An Early Diagnosis in Tuberculosis of the Middle Ear, Acta oto-laryng. orient. **1**:37-42, 1945.

20. Cooper, H., and Latorre Aguero, A.: Tuberculous Petromastoiditis, Rev. otorrinolaring. **5**:289-292 (Dec.) 1945.

21. Tavani, E.: Contribution to the Study of Nasal Tuberculosis, Omnia med. **19**:33-60 (Jan.-Feb.) 1941.

that of a patient with tuberculous lesions of the nasopharynx, the second that of a patient with Boeck's sarcoid who presented a tuberculoma of the nose, and the third that of a patient with tertiary syphilis of the nose in whose case histologic examination showed confusing pseudo-tuberculous findings.

The author reports that in several cases tuberculous granulations of the nasal septum were successfully treated with radium, which therefore deserves a diagnostic trial.

Brown-Kelly [22] presents the case of a 45 year old naval gunner who showed obstruction of the left nostril with persistent discharge of a mucopurulent fluid of fetid odor. Rhinoscopic examination revealed an ulcer of the left wall of the nasal septum which was surrounded by granulation tissue. Biopsy revealed tubercle bacilli. During the following four weeks the process extended through the septum to the right nostril. The patient could not be followed up any further, as he was transferred to another hospital.

This case is of academic interest because it presents an instance of tuberculosis of the nose in the absence of tuberculosis of the lungs. Roentgen examination of the lungs showed nothing abnormal.

Baccarani [23] describes the clinical entity of tuberculous rhino-bronchitis. The first impression might be that of the banal cold, but the stubborn recurrence in contrast to the complete absence of objective nasal findings might steer the clinician's attention toward the underlying tuberculous bronchitis. The significance of a thorough individual and family history and the value of roentgen examination of the chest are stressed in conjunction with tuberculin tests, which not infrequently might cause an exacerbation of the syndrome.

Bertelli [24] presents a clinical discussion of nasopharyngeal tuberculosis. The article, comprising 20 printed pages, is too extensive to be abstracted, but its reading can be warmly recommended to any one interested in this somewhat neglected subject, because it represents a sound and thorough study with numerous literary references. It has little to offer to the practitioner or the specialist who is interested in the latest therapeutic advancements.

The problem of tonsillectomy in tuberculosis and the treatment of pharyngeal tuberculosis and dysphagia find special consideration.

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22. Brown-Kelly, H. D.: A Case of Tuberculosis of the Nose, J. Roy. Nav. M. Serv. **28**:61-62 (Jan.) 1942.

23. Baccarani, C.: Tuberculous Rhino-Bronchitis, Otol. ecc. ital. **12**:206-217, 1942.

24. Bertelli, J. A.: Nasopharyngeal Tuberculosis, An. Cáted. de pat. y clín. tuberc. **5**:348-368 (Dec.) 1943.

The classification given by Bertelli should be of didactic interest and is therefore quoted herewith:

A. Tuberculosis of the nasal fossae (nostrils)
   1. Lupus
   2. Ulcerative form
   3. Latent form (Moure and Brindel)
   4. Pseudoatrophic form
   5. Tumoral form (tuberculoma of the nostrils)
   6. Pretuberculous coryza

B. Rhinopharyngeal tuberculosis
   1. Ulcerative
   2. Tumoral
   3. Lupus
   4. Latent

C. Tuberculosis of the tonsils

D. Oropharyngeal tuberculosis
   1. Lupus
   2. Acute form (bacillemia)
   3. Chronic
      (a) ulcerocaseous
      (b) latent (adenitis and chronic hypertrophy)
   4. Acute miliary pharyngolaryngeal (Isambert's disease)

Stirk Adams [25] reports the case of a 78 year old brass foundry worker who first consulted him because of a discharge of the right nostril. Examination revealed dental caries on the upper right side, dermatitis of the upper lip and poor transillumination of each maxillary sinus. Bilateral puncture of the antrums brought forth purulent secretion. The persistence of the infection finally necessitated intranasal antrostomy. About a half year later the patient returned, complaining of frontal headache, pain of the right upper gum and swelling of the right lacrimal sac. After roentgenologic examination, which revealed opacity of the right maxillary sinus but no destruction of bone, biopsy was decided on. The surgical approach was through a sublabial incision, which permitted escape of a moderate amount of pus. The histologic examination revealed senile tuberculosis. It was then supplemented by a roentgen study of the chest, which showed bilateral apical calcification. The author surmises that the infection spread from the lungs to the antrums by the hematogenous route.

In the introduction to their article Szanto and Hollender briefly mention eight articles on tuberculosis of the nasopharynx from the older

25. Stirk Adams, W.: A Case of Senile Tuberculosis of the Maxillary Antrum, J. Laryng. & Otol. **59**:250-251 (July) 1944.

26. Szanto, P. B., and Hollender, A. R.: Tuberculosis of the Nasopharynx, Ann. Otol., Rhin. & Laryng. **53**:508-521 (Sept.) 1944; abstracted, Dis. of Chest **11**:227-232 (May-June) 1945.

literature. They then discuss their postmortem observations. In 134 consecutive necropsies done at the Chicago State Hospital they found 24 cases of pulmonary tuberculosis, in 18 of which (75 per cent) there was associated tuberculosis of the nasopharynx, in 6 laryngeal involvement and in 3 tuberculosis of the palatine tonsil. The inadequacy of mere gross examination and the necessity of supplementing it by microscopic section are stressed because 4 of the 18 cases with involvement of the nasopharynx were diagnosed only after histologic examination. The more common sites of tuberculous lesions of the nasopharynx are the posterior part of the roof and the upper part of the posterior wall, which are the most likely to come into contact with infected sputum. Hematogenous spread seems to be the exception. No involvement of the middle ear was found.

The significance of open tuberculous ulcers of the nasopharynx as a possible source of reinfection of the lungs is mentioned. Furthermore, they might be interesting as the source of infected sputum in the presence of arrested pulmonary tuberculosis. This pathologic survey emphasizes the importance of careful clinical examination of the nasopharynx in cases of pulmonary and laryngeal tuberculosis.

Radner and Pinkerton [27] give an extensive history of a patient whose sputum was persistently positive in the presence of minimal pulmonary tuberculosis. This sputum derived from a tuberculous antral infection. While tuberculosis of the antrum is one of the more unusual complications of pulmonary tuberculosis, its significance as a potential source of sputum containing Koch's bacillus should be kept in mind.

The diagnosis was made by a bacteriologic "workout" of antral washings (smears, cultures and guinea pig inoculation) and by histologic examination of some hyperplastic tissue excised following bilateral antrostomy. The microscopic examination revealed fibrosis with well defined granulomas and giant cells. Five literary references precede this publication.

Sciuto and the Castiglioni [28] Alonsos present the case of a 25 year old woman with pulmonary tuberculosis who was treated by artificial pneumothorax and gold and calcium medication. While her pulmonary disease was being cured, a tumor developed in her right nostril, which caused considerable nasal obstruction and deformity. The tumor itself was dark red, with a knobby surface, and was rather soft on palpation; it was anchored at the nasal septum and protruded toward the lateral nasal wall. It bled spontaneously and gave rise to a mucopurulent nasal discharge. After a time it perforated through the cartilaginous septum.

27. Radner, D. B., and Pinkerton, F. J.: Tuberculosis of the Antrum, Am. Rev. Tuberc. **50**:313-315 (Oct.) 1944.

28. Sciuto, J. A.; Castiglioni Alonso, J. C., and Castiglioni Alonso, H.: Nasal Tuberculosis, Rev. Asoc. méd. argent. **59**:36-38 (Jan. 15-30) 1945.

A specimen of tissue was excised for biopsy, and histologic examination classified the tumor as tuberculoma. General considerations of nasal tuberculosis, its etiologic factors, morbid anatomy and diagnosis conclude this paper.

TUBERCULOSIS OF THE MOUTH

Dechaume [29] maintains that while tuberculosis might have an oral port of entry (tonsils, gingiva), the buccal lesions are usually secondary; they may involve the soft tissues, the antrums, the salivary glands or the lymph nodes. Some maxillary abscesses which formerly would have been diagnosed and treated as tuberculous osteitis are now considered to be the result of trauma of the incisors, being analogous to other abscesses of dental origin. Frequently they respond promptly to simple dental treatment. Tuberculous maxillary cellulitis is an extremely rare complication even in cases of far advanced pulmonary tuberculosis. Two instances are reported in which histologic examination revealed typical tuberculous structure of maxillary lesions. One of the patients had pulmonary tuberculosis; the other was apparently free from active pulmonary lesions. In both patients the lesions responded favorably to ultraviolet radiation.

Julliard [30] reports the case of a 50 year old man presenting a verrucous tuberculous lesion of the gingiva beneath the left lower wisdom tooth. Three years later the patient presented the same type of lesion symmetrically located on the right side. After excision, the healing occurred promptly, and there was no recurrence.

Portas [31] gives a short discussion of tuberculosis of the oral cavity without adding any new information. While primary tuberculosis of the mouth is exceedingly rare, secondary lesions might occasionally be encountered in the course of pulmonary involvement. The localizations, in the order of frequency, are the tip of the tongue, the gums of the upper and the lower jaw, the lips and the salivary glands. The most common forms are lupoid ulcerations and nodular lesions.

The importance of routine examination of the mouth of the patient who has pulmonary tuberculosis is stressed and with it the histologic examination to confirm the diagnosis.

Banyai and Fitzgerald,[32] after reviewing the literature on oral tuberculosis, the various forms of tuberculous lesions of the tongue and

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29. Dechaume, M.: Tuberculosis and Perimaxillary Cellulitis of Dental Origin, Presse méd. **50**:260 (March 4-7) 1942.

30. Julliard, C.: Bilateral Verrucous Tuberculosis of the Gingiva, Rev. méd. de la Suisse Rom. **62**:601-606 (July 25) 1942.

31. Portas, A. F.: The Mouth in Tuberculosis, Rev. españ. de tuberc. **11**:556-557 (Sept.) 1942.

32. Banyai, A. L., and Fitzgerald, R. J.: The Treatment of Oral Tuberculosis, Urol. & Cutan. Rev. **47**:299-303 (May) 1943.

the symptoms, discuss the treatment of oral tuberculosis, particularly the topical application of cod liver oil. The authors highly recommend cod liver oil because it is nonirritating, has a bacteriostatic and bactericidal effect, particularly on secondary organisms, increases the metabolic rate of leukocytes and the liquefaction of necrotic tissue, reduces the toxicity of pus, stimulates granulation and facilitates epithelization. The patient should be trained to apply cod liver oil to the diseased mucous surface at frequent intervals, because the continuous contact of the oil is essential. The oil might be applied topically (1) by daubing deep ulcers with soaked cotton pledgets, (2) by having the patient hold such pledgets to the diseased area, (3) by sloshing the mouth frequently with cod liver oil and (4) by spraying. The results manifested clinically were diminution of mucopurulent exudate, decrease of perifocal congestion and edema, formation of granulation tissue, epithelization and healing of ulcers, and, subjectively, cessation of pain.

Four case histories are added and 25 literary references in which there is discussion of the experimental and clinical use of cod liver oil.

Weinberger [33] analyzed the case material of about 5,000 patients with pulmonary tuberculosis at Montefiore Hospital and found that 1 to 1.5 per cent had secondary tuberculous involvement of the oral mucosa. Tuberculosis of the mouth was found to be about four times as frequent in men as in women, with a preponderance for the ulcerative type of lesion, while the miliary and infiltrative forms were more rarely encountered. The type of lesions and the route of infection are described in detail. A diagnostic tabulation is added, differentiating oral tuberculosis from traumatic erosions, syphilis and neoplasms.

The author reports the case of a patient presenting ulceration of the mucosal surface of the right cheek. A specimen excised for biopsy revealed chronic granulomatous inflammation with tubercle formation and focal ulceration. Ziehl-Neelsen stain revealed Koch's bacilli. Roentgen examination of the chest showed far advanced pulmonary tuberculosis and supplemented the diagnosis. In addition to dental repair the patient received a trial treatment with heliotherapy and quartz lamp radiation and then sulfanilamide therapy, evidently for the clearing away of the secondary organisms.

Wissler [34] reports a survey at the Children's Hospital of the University of Zurich (Switzerland) spanning three years which revealed 10 patients with tuberculous lesions of the gingiva. The early clinical findings usually were unspectacular—perhaps slightly reddened and spongy areas on the gingiva with single or multiple nodules of the

33. Weinberger, A. V.: Tuberculosis of the Buccal Mucous Membranes, Am. J. Digest. Dis. **10**:421-424 (Nov.) 1943.

34. Wissler, H.: On Primary Oral Tuberculosis, Schweiz. med. Wchnschr. **73**:1483-1486 (Dec. 11) 1943.

common form of granulation tissue and enlargement of the cervical lymph nodes beneath the horizontal mandibular branch.

The case histories of 6 children from 6 to 10 years of age who probably had primary tuberculosis of the oral mucosa are given in detail. Two of the 6 died of tuberculous meningitis, and the diagnosis was verified at autopsy.

The primary oral lesion might start as a small ulcer with perifocal infiltration and surrounding nodular swelling. Histologically, one might recognize a typical tubercle formation or only a nonspecific granulation tissue which might lead to the erroneous diagnosis of the banal chronic gingivitis.

The role of dental caries and nonspecific oral infection as a predisposing factor should be kept in mind. In contrast to lupus of the buccal mucosa, primary oral tuberculous lesions usually show a tendency to heal unless hematogenous dissemination leads suddenly to fatal tuberculous meningitis.

Brodsky and Herschfus [35] used penicillin in tablet form in the treatment of 28 patients with oral lesions, among whom were 13 patients with periodontoclasia, 5 with Vincent's angina and 10 with miscellaneous conditions (sinusitis, abscesses, etc.). The results in the first, and second groups showed a good response to the oral use of penicillin, while those in the miscellaneous groups showed moderate to satisfactory improvement. This paper contains no special reference to oral tuberculosis, but its origin from Sea View Hospital makes likely that the subject material consisted of patients with pulmonary tuberculosis and secondary coincidental oral involvement.

Cusatelli [36] discusses the pathologic and clinical aspects of tuberculosis of the tongue, with special consideration of the problems of its differential diagnosis. He emphasizes the significance of biopsy in doubtful cases. A survey of the medical and surgical management recapitulates the conventional methods. Two case histories are given.

Sézary, Bolgert and Plas [37] report the case history of a 66 year old man who presented a small ulcer under the tip of the tongue which gradually swelled until the anterior half of the tongue was about twice its usual size. In addition to pronounced local tenderness there was occasional pain in the mandibular joint. The regional cervical lymph nodes were enlarged. Death occurred seventy days after the initial examination, and autopsy revealed bilateral pulmonary tuber-

35. Brodsky, R. H., and Herschfus, L.: Oral Penicillin in the Treatment of Oral Lesions, Quart. Bull., Sea View Hosp. **7**:55-61 (Jan.) 1946.

36. Cusatelli, A.: Tuberculosis of the Tongue, Arch. ital. di otol. **54**:123-142, 1942.

37. Sézary, A.; Bolgert, M., and Plas, F.: Massive Hypertrophic Tuberculosis of the Tongue, Ann. de dermat. et syph. **8**:168-169 (Feb.) 1942.

culosis with cavitation of the upper part of the right lung; the lingual ulcer was surrounded by multiple, partially caseous infiltrations of typical tuberculous structure.

According to Jullien and Rozier,[38] tuberculosis of the tongue is rare. In 40 years of practice in a health resort for the tuberculous they observed only 10 cases of lingual tuberculosis. The disease occurs in three forms: usually as ulcer and rarely as lupus and cold abscess. No cases in which the lesion of the tongue was primary are described; in all the cases observed the involvement was secondary to far advanced pulmonary tuberculosis and not infrequently was associated with laryngeal or pharyngeal involvement. The spread to the tongue occurs as a rule through sputogenous infection. Traumatic erosions of the tongue irritated by tobacco, dental caries or faulty dentures are predisposing factors and should be promptly corrected. The tuberculous ulcer may appear suddenly, and its first subjective manifestation is usually pain, which shows the characteristic exacerbation on contact of food and sometimes radiates unilaterally to the ear. The subsequent dysphagia leads to malnutrition with all its deleterious implications. Once the ulcer is well established, salivation is frequently observed. Favorite sites for tuberculous ulceration are the root, the margin and the tip of the tongue, while the base is usually free. There is no induration and no swelling of lymph nodes. The differential diagnosis has to exclude syphilis, which presents indurated and indolent ulcers with adenopathy and is usually readily confirmed by a positive Wassermann reaction; cancer presents a more scooped-out appearance and also is accompanied by multiple swellings of regional lymph nodes and finally traumatic dental ulcerations. The biopsy is frequently of decisive importance.

The treatment of tuberculous ulcerations tends to give symptomatic relief by the local use of analgesic drugs. The small and circumscript lesion might be excised; others might be successfully treated by galvanocauterization. It is noted that some lingual ulcers heal independently of the course of the pulmonary lesions.

Hollander, Shelton and Shonfield [39] do not consider tuberculosis of the tongue an infrequent complication of systemic tuberculosis; the study of autopsy material revealed a percentage of 19.9. The anterior two thirds of the tongue is more commonly involved, and abrasions caused by dental defects, lack of oral hygiene and mechanical incompetence all seem to be of pathogenic importance. Among the various classifications of lingual tuberculosis, those of Katz, Ormsby and Kümmell are of particular academic interest.

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38. Jullien, W., and Rozier, J.: The Tuberculous Ulcerations of the Tongue, Rev. de la tuberc. **8**:118-120 (July-Sept.) 1943.

39. Hollander, L.; Shelton, J. M., and Shonfield, L.: Tuberculosis of the Tongue, Dent. Items of Interest **66**:107-122 (Feb.) 1944.

Katz: (1) ulcer, (2) tuberculous fissures, (3) combination of ulcer and fissures, (4) tuberculous granuloma, (5) tuberculoma and (6) tuberculous glossitis.

Ormsby: (1) nodular form, (2) ulcerative form and (3) papillomatous-verrucous form.

The classsification of Kümmell mentions somewhat sketchily only two forms: (1) tuberculoma of Esmarch and (2) tuberculous fissure.

Diagnosis has to differentiate tuberculosis from syphilis and cancer, either of which might be coexisting, and the importance of the microscopic examination cannot be overemphasized in this connection. Pain and tenderness are variable symptoms; absence of palpable regional lymph nodes in indurative or ulcerative lingual tuberculosis is of diagnostic significance and might help to rule out cancer. Poor dental hygiene or jagged and broken teeth may point toward traumatic erosion.

Six cases are reported, with comments on the gross anatomic and histologic observations. All the patients were men past the age of 40 with advanced pulmonary tuberculosis and a grave prognosis because of their low general resistance; all were "heavy smokers," and most of them showed poor dental hygiene. According to the morbid anatomy, the cases were classified as 1 of nodular, 3 of ulcerative and 1 of fissural tuberculosis, and 1 of ulcerative tuberculosis within a leukoplakia.

In a series of interesting histories of dental and oral disease, Goldman [40] describes a case of a 48 year old seaman with far advanced pulmonary and intestinal tuberculosis who had an ulcer excised from the mucosal surface of the right cheek. The histologic examination of the specimen revealed the tuberculous nature of the ulcer. The report is illustrated by a photomicrograph.

Among 66 patients with tuberculosis of the tongue Marano and Bancalari [41] found 11 with small, firm, painless lymph nodes in the carotid end of the submaxillary region. Satellite adenopathy is a rare finding in patients with tuberculosis of the tongue; its presence is conditioned by anatomic, constitutional and infectious factors. Histologic examination is of the utmost importance when ulcers in patients without evidence of active pulmonary tuberculosis are suspected of being tuberculous.

Silva [42] reports that in general tuberculosis of the tongue is a secondary manifestation that may be traced to a primary infectious focus either in the larynx or in the lungs. In the medical literature

40. Goldman, H. M.: Case Reports from the Files of the Registry of Dental and Oral Pathology: Tuberculous Ulcer of the Tongue, J. Oral Surg. **302**:279-280 (May) 1944.

41. Marano, .A., and Bancalari, C. A. Tuberculosis of the Tongue, Arch. argent. de tisiol. **20**:284-294 (July-Sept.) 1944.

42. Silva, G.: Tuberculosis of the Tongue, Hospital, Rio de Janeiro **27**:415-423 (March) 1945.

one finds reports of a few cases of isolated primary tuberculosis of the tongue. According to statistics, the primary complex of the tongue is exceptional. The lingual localizations secondary to pulmonary tuberculosis are observed more frequently, but they are not too common either. Men are more often affected than women, most of the patients being between 30 and 50 years of age. The continuous passage of tuberculous material which is in persistent contact with the buccal mucosa is the main factor in contamination, and implantation is favored by lingual erosions of dental traumatic origin. Ulceration of the tongue is observed more frequently on the margin and the dorsal surface of the tongue and less frequently on the tip and the ventral surface. The lesion may consist of a single ulcer or of two or three ulcers which have a tendency to conglomerate into one large defect containing caseous material. These lesions measure from 1 to 2 cm. in diameter and a few millimeters in depth. Their edges are infiltrated and cleancut; the bottom is irregular, granulous and covered by detritus. The base is indurated to palpation, and the lesion has a tendency to bleed easily. Even for those who are accustomed to make a systemic examination of the mouth, the diagnosis of tuberculosis of the tongue is not always easy to make.

Differential Diagnosis

Tuberculosis	Syphilis	Cancer
Age: 30 to 50	Variable	40 to 60
Pulmonary tuberculosis in family	History of hereditary or acquired venereal disease	
Past history of pulmonary tuberculosis	Disappearance after specific treatment	
Contact with patient proved to have pulmonary tuberculosis	Histologic study shows primary or tertiary syphilitic lesions containing treponemes	
General condition—loss of weight, cough, expectoration and fever	General condition—variable	General condition—loss of weight
Ulcer has irregular edges with induration at the base, granulation at the bottom	Ulcer situated at tip or on dorsal surface—single; rounded, regular edges; smooth bottom; indurated base	Ulcer situated posteriorly—irregular, single, vegetative, hemorrhagic, necrotic surface, foul odor
Usually no adenopathy	Early and painful adenopathy	Early and multiple adenopathy
Catarrhal secretion contains acid-fast bacilli	Catarrhal secretion contains no acid-fast bacilli	Catarrhal secretion contains no acid-fast bacilli
Acid-fast bacilli	Treponema pallidum	Cultures negative for these organisms
Serologic tests negative	Serologic tests positive	Serologic tests negative
Histologic study shows tuberculous lesion containing acid-fast bicilli	Histologic study shows primary or tertiary lesions containing treponemes	Histologic study reveals presence of tumor cells and absence of microorganisms

The author presents 3 cases of tuberculosis of the tongue in which this diagnosis was confirmed by histologic examination.

Titche [43] gives a short review of the literature on tuberculosis of the tongue with a critical discussion of the more important publications. Lingual localizations of tuberculosis are less rare than some authors imply.

The tongue is comparatively repellent to the implantation of tubercle bacilli, owing to the thickness of its mucosal layer and the general resistance of striated muscle tissue to tubercle bacilli, the cleansing effect of saliva and the continuous motion of the organ itself. Ulcers are by far the most frequent pathologic manifestation of lingual tuberculosis compared with fissures, tuberculomas, granulomas and tuberculous glossitis. The cardinal symptom is pain.

In view of the fact that spread to the tongue usually occurs in the terminal stages of far advanced pulmonary tuberculosis, the treatment is mostly palliative. Cauterization might be tried, if feasible, preceded by excision of the lesion. The pain might be controlled by topical application of anesthetic agents, or if it is intractable, alcoholization of the lingual nerves might be attempted.

The author relates his experiences with 30 patients who presented lingual tuberculosis. Only 2 of them had moderately advanced pulmonary tuberculosis and in both the lesions of the tongue healed. The 28 patients representing the bulk of this group had far advanced pulmonary tuberculosis; all of them were men and the majority of them in their fourth decade of life. The ratio of white and Negro patients was approximately 6 to 1. Little more than half the patients had associated tuberculous laryngitis; one-third had oral and pharyngeal tuberculosis, and 3 patients (10 per cent) had tuberculous enteritis.

Pagel [44] reviews the literature on primary tuberculosis of the tonsils, the relation to cervical adenitis and the criteria for a primary tuberculous focus in the tonsils. He concludes that the tonsils only rarely show a true primary complex and that in patients with massive primary alimentary infection the tonsils together with other parts of the digestive tract might not infrequently be involved. This paper is a critical study and of academic interest mainly to the pathologist, less to the clinician.

Gugi [45] discusses the indications for, and the results of, tonsillectomy, which in his opinion are more or less the same in tuberculous as in nontuberculous patients. His approach for surgical intervention is liberal, especially with those patients whose tonsils may safely be assumed to be the focus of recurrent infection. Tonsillectomy is contraindicated in cases in which clinical signs point toward a poor general physical

43. Titche, L. L.: Tuberculosis of the Tongue, Am. Rev. Tuberc. **52**:342-344 (Oct.) 1945.

44. Pagel, W.: Primary Tuberculosis of the Tonsils, Pract. oto-rhino-laryng. **4**:279-284, 1942.

45. Gugi, T.: Value and Indication of Tonsillectomy in Tuberculous Patients, Orvosi hetil., 1942, pp. 28-29; cited, Ztschr. f. d. ges. Tuberk.-forsch. **55**:286 (Sept.) 1942.

condition and unfavorable immunity—e. g., a persistently elevated temperature and a high pulse rate.

Wissler [46] comments on the indication for tonsillectomy in children with tuberculous cervical adenitis. The histologic study of 47 operative specimens of tonsils removed from patients with tuberculous adenitis showed tuberculous changes in 34 instances, that is, approximately 72 per cent. This confirms Schlitter's findings in 1934; he found evidence of tuberculosis in extirpated tonsils in about 50 per cent of cases. These biopsy findings should urge the throat specialist to perform tonsillectomy in children with tuberculous lymphadenitis provided the general condition is satisfactory. There is no clinical evidence, however, that there are fewer relapses and exacerbations of cervical tuberculous adenitis in tonsillectomized children as compared with an analogous group of patients not operated on.

Removal of the tonsils might contribute to the healing of long-standing fistulas but does not seem to prevent the possibility of a progressive course of the specific adenitis even if performed at an early stage.

Bertelli and Pasel Jardim [47] describe their equipment and technic for photographing pharyngeal lesions with a view to illustrating their teaching material. Among the examples given there is a photograph of pharyngeal tuberculosis with an ulcer of the right tonsil and another of the ulcerative micronodular form of pharyngeal tuberculosis (Isambert's disease). (Comment: While the reviewers are not familiar with photographic technic and standards, they feel that the illustrations do not compare favorably with the ones displayed in our own textbooks and journals.)

Bernstein [48] in his recent discussion of tuberculosis of the tonsils describes the vascular supply of these organs and then gives a short survey of the literature of the subject and the incidence of the disease according to various authors. The estimates range from 40 to 70 per cent for latent tuberculous involvement of the tonsils, while clinical tuberculosis of these organs is extremely rare (2 to 3 per thousand patients presenting such involvement).

A short paragraph is devoted to the pathogenesis, the author distinguishing between primary involvement, the tissues being invaded directly by bacilli from air-borne droplets or from the alimentary canal, and secondary involvement through sputogenous, hematogenous or

46. Wissler, H.: Tonsillectomy and Tuberculous Cervical Adenitis, Schweiz. med. Wchnschr. **75**:927-928 (Oct. 20) 1945.

47. Bertelli, J. A., and Pasel Jardim, J.: Equipment and Technique for Photography of the Pharynx, An. Cáted. de pat. y clín. tuberc. **4**:156-165 (June) 1942.

48. Bernstein, D.: Tuberculosis of the Tonsils, Arch. Otolaryng. **44**:280-286 (Sept.) 1946.

lymphogenous spread. A report of 4 cases of latent tuberculosis of the tonsils is added, all of which are of particular interest. One of the patients, in whom pulmonary tuberculosis was apparently arrested, had to have a tonsillectomy because of recurrent follicular angina. Another one had persistently positive sputum without roentgenologic evidence of active pulmonary tuberculosis and without tracheobronchial disease on bronchoscopic examination. Two of the patients who produced sputum containing tubercle bacilli had bacillus-free sputum after tonsillectomy. Three of the 4 patients improved promptly after tonsillectomy, and the fourth was already on the way to recovery.

The author stresses the observation that tonsillectomy is not connected with any particular risk in the tuberculous patient provided the general condition of the patient is good; it might prove beneficial by the elimination of focal infection.

Janssen,[49] evidently a pathologist in Davos, Switzerland, comments on the pathogenesis of laryngeal tuberculosis. His observations are founded on necropsy material of 208 cases of pulmonary tuberculosis, in 37 of which (18 per cent) associated tuberculosis of the larynx was shown. He briefly discusses the lymphatic route of infection, which, in spite of frequent mention in the older literature, seems exceedingly rare in comparison with blood-borne and contact infection. The tuberculous involvement of the epiglottis is generally considered as a hematogenous spread. Among 7 cases in which autopsy disclosed tuberculous lesions of the epiglottis, Janssen noted 1 case which was definitely and 3 which were probably instances of blood-borne infection, while in the remaining 3 cases implantation of sputum-borne bacilli was the most likely pathogenic factor. The paper is summarized as follows:

1. Tuberculosis of the epiglottis does not always represent a hematogenous infection.
2. In pulmonary tuberculosis, involvement of the epiglottis is a frequent but not exclusive localization.
3. Tuberculosis might spread to the epiglottis through the canalicular as well as through the hematogenous route.

During his studies the author encountered a case of primary laryngeal tuberculosis.

Mathé [50] gives a survey of the therapeutic means at one's disposal in the treatment of dysphagia caused by tuberculous laryngitis. All the conventional remedies are mentioned, as well as numerous proprietary preparations unavailable to the American otolaryngologist. All

49. Janssen, T.: Contribution to the Pathogenesis of Laryngeal Tuberculosis, Beitr. z. Klin. d. Tuberk. **97**:64-70, 1941.

50. Mathé, K.: The Treatment of Dysphagia in Laryngeal Tuberculosis, Beitr. z. Klin. d. Tuberk. **97**:80-84, 1941.

secondary infections of the upper respiratory tract and nasal sinuses, dental caries and infected tonsils should be treated. Volatile oils for nasal application, sulfonamide drugs and colloidal silver preparations for antisepsis, short waves, ice collars, cold compresses, passive congestion according to Bier, topical application of cocaine derivatives for pain, are mentioned, also vocal rest, whispering, symptomatic relief of cough, use of analgesic lozenges and insufflation of powders, roentgen irradiation and the old-fashioned lactic acid treatment. Finally the author discusses the alcoholization of the superior laryngeal nerve, and if this is unsuccessful, he tries alcohol block of the glossopharyngeal nerve, which seemed particularly promising for lesions of the anterior part of the larynx, the base of the tongue, the pharynx and the tonsils.

Wessely's [51] paper represents a group of postgraduate lectures on laryngeal tuberculosis evidently prepared for an audience of general practitioners. After a brief discussion of the etiology and the clinical aspects of tuberculous laryngitis, the therapeutic means commonly used to favor cicatrization are enumerated: electrocautery, heliotherapy, ultraviolet radiation, mercury vapor lamp, roentgen radiation and radium. The matter is well covered in its essentials but somewhat dated and more of literary than of clinical interest.

Penna [52] surveys 446 tuberculous patients, 370 (82.9 per cent) of whom suffered from secondary involvement of the upper respiratory tract. The vast majority (94.3 per cent) had tuberculous laryngitis either isolated or associated with other lesions of the oropharynx or the nasopharynx. To a report of 11 cases, tabulations are added, analyzing the involvement of the different organs of the upper respiratory tract, the pathologic type of lesions, the age of the patients and the treatment applied. Since 1933 the author used instillations of chaulmoogra oil with generally good results. Of 190 patients treated with the oil, 33 (17 per cent) were considered cured, 80 (40 per cent) markedly improved and 61 (30 per cent) fairly well improved, while the remaining 25 (12 per cent) did not show any change. The author asserts that the beneficial results in 57 per cent of the entire material definitely justify a therapeutic trial of chaulmoogra oil.

Some general remarks on the role of the otorhinolaryngologist and the importance of his cooperating with the clinician conclude this paper.

Zobin [53] devised a new treatment for the relief of dysphagia in laryngeal tuberculosis. Before describing the technic and the results

51. Wessely, E.: Laryngeal Tuberculosis, Wien. klin. Wchnschr. **54**:841-843 (Oct. 10) 1941.

52. Penna, M.: Tuberculosis in Oto-Rhino-Laryngology, with Special Consideration of Tuberculous Laryngitis, Rev. med.-cir. do Brasil **49**:613-629 (Nov.) 1941.

53. Zobin, I. S.: Neurologic Method in the Treatment of Laryngeal Tuberculosis, Probl. tuberk. **3**:36, 1942.

of his operation, he discusses its morbid-physiologic foundation, picturing the degenerative changes caused by the tuberculotoxins in the central and sympathetic nervous systems in general, as well as locally at the larynx. As Alperne has proved experimentally, functional changes of the autonomic nervous system have a definite influence on the inflammatory processes, the reversal of which is retarded by overactivity or stimulation of the sympathetic nerves, while hypofunction and paralysis of the same nerves stimulate healing and granulation; the resection of these sympathetic fibers improves scar formation. The periarterial sympathectomy of Leriche is based on these physiologic findings; the elimination of sympathetic vasoconstriction and spasm permits better blood supply and nutrition of the injured organ and thereby furthers the regenerative process. Having successfully applied this operation in the treatment of torpid ulcers, Zobin was inspired to apply it in that of tuberculous ulcers of the larynx, but he modified the technic to avoid the complications not infrequently observed after arterial decortication, such as necrosis, thrombosis and secondary infections. Instead of the usual resection of the sympathetic fibers, he chose alcohol infiltration of the superior laryngeal artery combined with resection of the superior laryngeal nerve to relieve dysphagia and dysfunction caused by nerves damaged by tuberculotoxins.

We quote Spencer,[7] who gives a detailed translation of the Russian original as to the technic of the operation.

> . . . The technique consists in having the patient in position with head thrown back and to the side. A horizontal incision is made between the sublingual bone and the upper margin of the thyroid cartilage. The above incision exposes the omohyoid and sternohyoid muscles above the thyroid cartilage; the muscles are drawn toward the median line, thus freeing the quadrangular space filled with connective tissue. The superior laryngeal artery is freed of the adjacent tissue and thoroughly dabbed with 85° alcohol. A length of about 1 to 1.5 cm. is excised. A catgut suture is applied to the fascicule and silk to the skin.

After operation there might be observed a decrease of secretion and exudation, then a gradual cleansing of necrotic material from the ulcer and with this an improved tendency toward granulation and regeneration of the mucosal surface. Clinically, the beneficial effect of the neurosurgical intervention might be manifested by improved deglutition, better intake of food and decrease of coughing.

The surgical material represents 25 patients with far advanced pulmonary tuberculosis and associated tuberculous laryngitis on whom 32 operations were performed. Of these 25 patients, 12 had bilateral tuberculosis with caseation, 12 had bilateral fibrotic tuberculosis with cavitation and 1 had unilateral fibrotic tuberculosis with cavitation. Eighteen were treated with combined alcoholization of the superior laryngeal artery and resection of the superior laryngeal nerve, while 7 received only alcohol infiltration. The results were as follows: One

larynx healed after four months, 1 after five months and 1 after nine months. Eight patients showed laryngeal improvement, but 5 of them died later of systemic tuberculosis. Eleven patients had no improvement, and 8 of these died.

The author draws the conclusion that sympathectomy is a palliative measure devised for the temporary relief of dysphagia and the stimulation of regenerative processes, while the ultimate decision still lies in the immunobiologic condition of the patient.

Guglielmetti and Porta [54] studied the effects of vitamin therapy in 20 patients with laryngeal tuberculosis. They dispensed thiamine hydrochloride, thiamine hydrochloride and ascorbic acid and preparations of vitamins A and D. After finishing their experiments, they concluded:

1. High doses of thiamine hydrochloride and ascorbic acid, occasionally improved laryngeal tuberculosis and facilitated healing, especially if followed by administration of vitamins A and D, which further calcification.

2. Edema and ulcer as a rule respond better to vitamin therapy than do proliferative lesions. Tuberculous chondritis and perichondritis were found to be only moderately responsive.

3. Vitamins are to be considered as having a nonspecific effect, probably stimulating local and general responses previously weakened by vitamin depletion. It is therefore necessary to give generous doses over a long period.

4. In cases of tuberculosis the laryngeal lesions seem to react better to vitamin therapy than the pulmonary ones. (From this observation the authors conclude that laryngeal tissue either shows a deficiency of thiamine and vitamin C or that it is better able to absorb these vitamins. Both deductions seem rather fanciful to the reviewers.)

5. There did not seem to be any correlation between the administration of vitamins and the course of the basic pulmonary disease.

Caliceti [55] discusses the indication for, and the value of, galvanocauterization and gold treatment of laryngeal tuberculosis. He considers cauterization contraindicated in acute exudative processes and in stenosing forms. There follows a description of the technic of cauterization correlating the type and the intensity of punctures (superficial or deep, pinpoint, grooved, etc.) with the nature and the extent of the laryngeal lesion (edema, ulceration, circumscript or extensive infiltration, etc.). Even when cauterization fails to bring the tuberculous lesion permanently under control, it frequently relieves pain and is therefore of considerable value as a palliative measure. Gold treatment was found comparatively successful in conjunction with galvanocauterization; it seemed that the latter was better tolerated and the regenerative process accelerated by the combined method.

54. Guglielmetti, P., and Porta, C. F.: Contribution to the Vitamin Therapy of Laryngeal Tuberculosis, Ann. Ist. Forlanini **6**:85-104, 1942.

55. Caliceti, P.: Evaluation of Several Measures in the Treatment of Tuberculous Laryngitis, Rassegna clin. scient. **20**:73-76, 1942.

Delarue [56] wrote an essay on the pathologic anatomy and the etiology of tuberculous laryngitis which, because of its superior quality, is abstracted here in detail.

THE LESIONS OF TUBERCULOUS LARYNGITIS

Macroscopic Aspects.—The commonest forms of laryngeal involvement occurring in the course of systemic tuberculosis are infiltrations, granulations, ulcerations, necrosis, pseudotumors, papillomatous or polypoid vegetations and stenosing sclerosis. The areas involved, in the approximate order of frequency, are the interarytenoid region, the posterior half of the vocal cords, Morgagni's ventricle, the ventricular bands, the epiglottis and the subglottic region. Of the numerous classifications of laryngeal tuberculosis, three are mentioned:

(1) Doleris: diffuse form, infiltrative form, circumscript form, mixed conjunctival diffuse form.

(2) Giraud: catarrhal form, infiltrative ulcerative form, infiltrative vegetative form

(3) Randerath: Productive forms: infiltrations, granulations, ventricular erosions. Destructive forms: miliary disseminations, arthritis, perichondritis.

(For didactic reasons the French author divides the laryngeal structures into three planes: the vestibular, the glottic and the subglottic.)

Histologic Observations.—The tuberculous foci involve principally the "chorion" of the mucosa, with initial localization in the islands of lymphoid tissue in the submucosa. The lesions are either exudative or follicular (caseous and noncaseous) or fibrous with all the intermediary and transitory forms. In addition to the tuberculous foci there may be all kinds of nonspecific lesions, temporary or permanent inflammatory manifestations (congestion, edema, diapedesis), glandular hypertrophy or atrophy, metaplasia, papillomatous and polypoid growths forming pseudotumors, diffuse sclerosis, degeneration of muscular tissue, calcification and ossification of cartilage, and sclerosis of nerves.

LARYNGEAL TUBERCULOSIS AS A MANIFESTATION OF SYSTEMIC TUBERCULOSIS

A primary tuberculous infection manifested by laryngeal chancre with cervical adenopathy is a form much discussed in the literature. The claim of this occurrence is contested by modern clinicians, who maintain that laryngeal tuberculosis is practically always secondary and that the diagnosis of this syndrome described in the older literature was arrived at by antiquated means of clinical diagnosis. This view is supported by modern pathologists.

1. Isolated chronic laryngeal tuberculosis. This classification comprises cases in which laryngeal tuberculosis presents the only clinical manifestation in a person infected some time previously or cases of exogenous reactivation or reinfection preceding active pulmonary lesions.

2. Laryngitis in patients with multiple extrapulmonary foci of tuberculosis. This is the so-called external tuberculosis. The patients show migrating tuberculous lesions without apparent pulmonary involvement, with localization in the skin, the kidneys, the bones, the glands and the larynx. This form differs from the ordinary tuberculous laryngitis and usually consists of extralaryngeal lesions affecting the thyroid cartilage and other parts of the osteocartilaginous tissues of the perichondrium and Morgagni's ventricle. Abscessed and fistulous forms are not infrequent.

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56. Delarue, J.: Morbid Anatomy and Etiology of Laryngeal Tuberculosis, Rev. de la tuberc. **7**:184-193 (June-Aug.) 1942.

(*a*) Relation between laryngeal and other tuberculous lesions of the upper respiratory tract (nose, tonsils, oral cavity and pharynx). Particularly mentioned are acute pharyngeal tuberculosis (*granulie pharyngée* of Isambert) and tuberculosis of Waldeyer's ring. The modern conception describes tuberculosis of the upper respiratory tract as a clinical entity with tuberculous laryngitis as its predominant and most frequently encountered feature.

(*b*) Relation between laryngeal and pulmonary tuberculosis. Tuberculous laryngitis secondary to pulmonary tuberculosis is still of cardinal clinical importance and of most common occurrence. Kanony rightly emphasized that laryngopulmonary tuberculosis is an important entity from the morphologic, etiologic, clinical and therapeutic points of view. The incidence of laryngeal involvement in patients with pulmonary tuberculosis averages about 17 per cent, but the figures in the literature vary greatly. Apparently there are many latent lesions, for autopsy figures are considerably higher, particularly if the autopsies are supplemented by histologic examination, ranging up to 50 per cent.

Tuberculous laryngitis occurs rarely in patients with the truly acute pneumonic or bronchopneumonic forms of tuberculosis. It is most frequently found in patients with the chronic fibrocaseous forms and in those with hematogenous miliary tuberculosis. It is difficult to establish any correlation between pulmonary and laryngeal involvement because of the complexity of systemic tuberculosis. Cases of homolateral tuberculosis have been described, also morphologic conformity between laryngeal and pulmonary lesions (miliary lesions or fibrous types, etc.).

PATHOGENESIS: PATHWAYS OF INFECTION

1. The canalicular route, or sputogenous infection. This is the oldest and most generally accepted theory, substantiated by long-known features, such as stagnation of sputum, involvement of the posterior commissure, irritation and congestion caused by cough, small erosions, vocal fatigue. Tubercle bacilli might pass directly through the epithelium of the mucosa or might penetrate through small superficial erosions which later on heal over or, finally, might invade through the excretory ducts of the submucosal glands. The author maintains that the bacillary content of the sputum is of secondary importance. Laryngeal implantation has been observed in some cases with a low Gaffky count, while, on the other hand, in some cases with a high count of tubercle bacilli involvement of the larynx has not been shown. Homolaterality of laryngopulmonary tuberculosis cannot be explained by contact infection.

2. The blood stream route, or hematogenous infection. In cases of miliary dissemination this pathogenesis has been substantiated by the finding of coexistent intestinal and laryngeal tuberculosis at autopsy. Furthermore, lesions in the deeper layers of the mucosa are more easily explained by blood stream than by contact infection.

3. The lymph channel route, or lymphogenous infection. The tuberculous infection may spread from subpleural lymphatic channels over the bronchial and then the cervical lymph nodes or originates from the submucous lymph ducts of the bronchi and trachea. This route would explain the coexistence of superficial ulcers of the bronchi and trachea as a sign of the continuity of a lymphangitic process. Lymph way infection should be accepted for lesions in the submucous layer and in the lymphoid tissue of Morgagni's ventricle; it finally finds corroborating evidence in pulmonary and laryngeal lesions showing homolateral and parallel evolution.

4. The modern view is eclectic, it recognizes all the three previously mentioned pathways as possible routes of infection.

As a closing remark, the author mentions that laryngeal and pulmonary tuberculosis represent a reactive synergy of two organs belonging to the same sphere of vascular and trophic innervation, which is in accordance with the modern conception that the neurovegetative system is of importance in infective disease. He stresses the significance of the cervical sympathetic nerve, regulating through its upper branches the nose and pharynx and through the lower ones the lungs, and the role of the stellar ganglion as a center of vascular and trophic regulation.

Delarue's paper is supplemented briefly by that of Leroux,[57] in which the clinical aspects and the therapeutic management of laryngeal tuberculosis are discussed.

1. Endolaryngeal lesions are mainly manifested by dysphonia. Because they are not as liable to have general effects, their prognosis is comparatively less grave than that of lesions of the laryngeal crown or that of pharyngolaryngeal involvement, with dysphagia, malnutrition and systemic debilitation. They are frequently characterized by unilateral or bilateral tuberculous corditis with thickening and sometimes superficial ulceration of the cords and arytenoids or granulation at the posterior commissure. At the subglottic plane, one usually finds unilateral eversion of Morgagni's ventricle or a fibrotuberculoma which might immobilize the entire hemilarynx and give rise to dysphonia. Collet describes a tumoral type which histologically was classified as a polyp of the anterior commissure.

2. Pharyngolaryngeal lesions are characterized by dysphagia and pain and inanition and, as a rule, they have a poor prognosis. The tuberculous ulcer, sometimes of considerable depth, might involve the epiglottis and the aryepiglottic fold and eventually spread to the pharynx. Pathologically, these lesions may be associated with perichondritis, arthritis of the cricoarytenoid cartilage; deep fistulas may finally transform the larynx into one big purulent cavity with gradual destruction of its landmarks. The therapeutic management for this entire group of lesions is usually palliative, in contrast to the sometimes successful efforts to cure the endolaryngeal type of lesion.

3. Charachon describes tuberculous laryngitis characterized by highly edematous infiltration which might lead rather suddenly to stenosis and is clinically characterized by laryngeal obstruction and dyspnea.

The author feels that there is practically no isolated laryngeal tuberculosis and that in at least 90 per cent of the cases the involvement of the larynx is secondary to pulmonary tuberculosis, the latter being generally the determining prognostic factor. Naturally there are reciprocal and determining factors between the lungs and the larynx. For instance, collapse therapy by pneumothorax might diminish the cough and by elimination of this mechanical irritation influence favorably

57. Leroux, L.: Laryngeal Tuberculosis from the Clinical and Therapeutic Point of View, Rev. de la tuberc. **7**:178-183 (June-Aug.) 1942.

the course of the laryngeal disease. On the other hand, laryngeal ulceration causing considerable dysphagia might interfere with improvement and resistance and thereby precipitate a pulmonary flare-up. The fibrotic type of pulmonary tuberculosis has a better outlook for the healing of the secondary laryngeal lesions than the exudative type.

TREATMENT

The general measures include resting in bed and remaining silent on the part of the patient and production of pulmonary collapse by phrenicotomy, pneumothorax, thoracoplasty or other procedures. The results of gold therapy are inconclusive, but at least most authors agree that laryngeal involvement is no contraindication. Tuberculin does not seem to have any curative effect but perhaps increases the general resistance.

The laryngeal treatment includes: (*a*) Topical hygienic measures. Inhalation, insufflation or instillations of oily solutions and intramuscular injections of Jacobson's solution (benzyl cinnamate) have been tried for cleansing and symptomatic relief.

(*b*) Curative measures. These include heliotherapy, ultraviolet radiation, galvanocautery and the cold spark. Roentgen ray and radium treatment have been found of doubtful value.

(*c*) Palliative measures. The galvanocautery may be useful; procaine hydrochloride or alcohol may be injected into the superior laryngeal nerve or the nerve may be resected. The recurrent nerve may be alcoholized and procaine hydrochloride may be injected into the stellar ganglion and into the upper three thoracic sympathetic ganglions.

Mollard, Maschas and Duret [58] give a brief discussion of the usual symptoms of tuberculous laryngitis, with special mention of the more rarely encountered asphyxia caused by edematous swelling or obstructing granulations. In these exceptional cases they recommend that procaine hydrochloride be injected into the stellar and superior thoracic ganglions according to the technic developed by Leriche to reduce edema and relieve dysphagia, giving the patient comparative comfort and facilitating the intake of food. Naturally the treatment is purely palliative.

Baleeiro [59] outlines the treatment of dysphagia due to tuberculosis of the larynx. First of all he advocates a semiliquid diet, which in extreme cases has to be administered through a nasal tube. He then enumerates and discusses the traditional therapeutic means and measures, such as cauterization, heliotherapy, topical application of anesthetic drugs by vaporization and pulverization, ionization and injection or resection of the superior laryngeal nerve. Neurotomy is advocated if the general condition of the patient is satisfactory, the pulmonary process not too

58. Mollard, H.; Maschas, H., and Duret, M.: Treatment of Edematous Laryngeal Tuberculosis with Novocain Injections into the Stellar and Superior Thoracic Ganglia, Rev. de la tuberc. **7**:193-194 (June-Aug.) 1942.

59. Baleeiro, A.: Treatment of Dysphagia in Tuberculous Laryngitis, Bahia med. **13**:147-154 (Aug.) 1942.

acute, the temperature not too high and if the tuberculous process in the upper respiratory tract has not yet spread beyond the field of innervation; it is contraindicated in patients who already have had repeated alcoholization of the nerve with tissue necrosis and involvement of the pharynx and trachea and persistently high temperature.

In a postgraduate lecture given at the Vienna Academy of Medicine, Wessely [60] discussed some aspects of tuberculosis and cancer of the larynx. While tuberculosis spreads to the larynx by contact infection in the majority of cases, e. g., those in which the infection is manifested as infiltrations and ulcerations of the vocal cords and the posterior commissure, about 10 to 20 per cent of the cases have to be considered as instances of hematogenous infection. In these cases the lesions may start as small subepithelial nodules and break to the surface as small isolated ulcers, which through confluence might form one extensive ulcer. Typical examples of hematogenous involvement are the circumscript lesions that appear during miliary tuberculosis and are manifested as infiltrations and ulcerations of the epiglottic and aryepiglottic folds or as a more generalized diffuse infiltration of the entire larynx. The tissue surrounding the tuberculous lesion might show considerable edema. The hematogenous involvement of the larynx frequently has a sporadic and migrative character, manifested by apparently spontaneous healing and, later on, sudden recurrence in various locations.

After briefly mentioning the importance of dysphagia and dyspnea, the author discusses his statistical extraction of the Viennese necropsy material. About 10 per cent of the patients who died of systemic tuberculosis showed laryngeal involvement. It is interesting to note that twice as many men as women were affected; the difference between the sexes was even more startling in the statistics for hematogenous laryngeal involvement; here the ratio was 7 to 1.

Kutschera-Aichbergen [61] observed 3 patients with far advanced pulmonary tuberculosis and laryngeal involvement who improved after an accidental tubercle bacillus infection of lesions of the skin. On the theory that the lupus was the determining factor in the radical change of course of the seemingly hopeless progressive pulmonary and laryngeal tuberculosis, the author began to work out intracutaneous implantation of tubercle bacilli as a therapeutic trial.

The technic of the vaccination is described in detail, and it should be emphazied that the tubercle bacilli, whether laboratory strains or cultures made from the sputum of the patient (autovaccine), should

60. Wessely, E.: Tuberculosis and Cancer of the Larynx, Wien. klin. Wchnschr. **56**:309 (May 7) 1943.

61. Kutschera-Aichbergen, H.: The Healing Influence of Lupus (Skin Tuberculosis) on Pulmonary and Laryngeal Tuberculosis, Wien. klin. Wchnschr. **56**:566-568 (Sept. 22) 1943.

be as virulent as possible, because lupus produced artificially by implantation is *a priori* weaker and less extensive than that caused accidentally by fresh autoinfection—from a tracheotomy wound, for instance.

The vaccination has to be repeated at monthly intervals, and the average treatment lasts approximately two years. The patients should be carefully selected. Eligible are patients with chronic productive tuberculosis of the lungs and the larynx that is following a slowly progressive, afebrile or subfebrile course who have not entered as yet the cachectic stage. Patients with highly febrile, massively exudative forms and those with giant cavities do not respond and are undesirable for a therapeutic trial. Frequently, improvement can be observed after the first three or four vaccinations and is evidenced by roentgenographic improvement of the pulmonary lesions, regression of the laryngeal involvement, normalization of the sedimentation rate and gaining of weight.

The author considers the superinfection of adults who have far advanced tuberculous lesions a comparatively harmless procedure in contrast to the quite dangerous prophylactic vaccination of healthy infants. He observed no complications, no focal reactions and no spread of the exogenously produced lupus, with the possible exception of the secondary effects of scratching, which should be carefully avoided. Summarizing his thirty years' experience of the treatment of tuberculosis, the author considers this type of treatment less dangerous than the injection of tuberculin or a gold compound and any collapse measure known to him, and he warmly recommends that it be more universally applied in the treatment of patients who otherwise would be abandoned to a hopeless fate.

Segre [62] concedes that in the treatment of laryngeal tuberculosis better results cannot be obtained by substituting some surgical method for the well accepted conservative ones; he merely intends to draw from his experience the advantages and convenience of surgical treatment of tuberculous laryngitis and point out the usefulness of certain operations, especially when they are associated with correct treatment of the pulmonary lesions. He distinguishes between direct and indirect procedures, the latter having a purely palliative scope and the former comprising those operations practiced on the larynx itself and at a distance (laryngeal sympathetic system, recurrent nerve, tracheotomy).

Indirect Interventions: During eight years the author observed several thousand patients affected with laryngeal tuberculosis, among whom five operations on the nasal septum and seven tonsillectomies on adults caused no impairment of the laryngopulmonary lesions, owing

62. Segre, R.: Surgical Treatment of Laryngeal Tuberculosis, Resenha clin.-cient. **12**:261-268 (July 1) 1943.

perhaps to the cautious selection of patients. In 2 tonsillectomized patients there was considerable postoperative hemorrhage; in 2 others there was definite improvement, first of the general condition, then of the pulmonary and laryngeal lesions. Histologic examination of the tonsils removed failed to show specific tuberculous lesions, and inoculations of guinea pigs produced no tuberculous lesions. The evolution of the laryngeal tuberculosis may be summarized as follows: Of 130 patients, 69 showed improvement, 29 impairment, 17 stationary lesions and 15 cure; of 19 patients who underwent thoracoplasty, 6 showed improvement, 4 impairment, 5 stationary lesions and 4 cure.

Biopsy is the only acceptable intervention when cancer is suspected.

Direct Interventions: Cauterization of tuberculous lesions brings about destruction of the painful zones and closure of blood vessels, and protects the patients, therefore, against hematogenous dissemination. At the same time, if it is done deeply and concentrically to the lesion, it produces formation of connective scar tissue, which acts as a barrier and may limit the lesion. It should not be practiced in cases of acute laryngitis or in cases of rapidly deteriorating pulmonary lesions. Complications are exceptional. When one is cauterizing the vocal cords or infiltrative lesions of the false cords, care must be taken not to destroy the thyroarytenoid muscle unless it is badly damaged.

Periaterial sympathectomy of the laryngeal artery has the purpose of increasing the circulation of the blood and therefore of improving the defensive reaction of the organ. These operations are being abandoned, however, owing to the insecurity of results.

Resection of the recurrent nerve has been practiced in a few cases, with encouraging results.

Cautery may be used in certain cases of epiglottic hypertrophy as a purely palliative treatment. Alcoholization of the laryngeal nerve is also a merely supportive measure.

Engler [63] presents the results obtained with roentgen therapy in cases of laryngeal tuberculosis. The introductory paragraphs are concerned with general remarks on the disease and bibliographic references. The author seems to prefer Rickmann's classification because of its didactic simplicity—(1) productive, (2) exudative, (3) mixed infection. He then surveys the literature, describing the types of laryngeal lesions selected for roentgen irradiation and the results of this treatment. Both the types of lesions and the results vary greatly according to the different authors. Fractional doses of roentgen radiation seem better tolerated and are largely preferred to large ones. The technic of irradiation is described in detail, the dosage recommended being that used at the City Hospital, Cleveland.

63. Engler, C. W.: Roentgen Therapy of Laryngeal Tuberculosis, Ann. Otol., Rhin. & Laryng. **52**:655-665 (Sept.) 1943.

Altogether 38 nonselected patients with laryngeal tuberculosis were treated in accordance with the technic described and the results were as follows:

In 8 (21 per cent), lesions healed: Four had exudative lesions; 2, productive lesions; 2, mixed type of lesions.

In 6 (16 per cent), lesions improved: Four had exudative lesions; 1, productive lesions; 1, productive lesions which turned exudative later.

In 8 (21 per cent), lesions were unchanged: Seven had exudative lesions; 1, productive lesions.

In 16 (42 per cent), lesions got worse: All 16 had exudative lesions. The histories of 6 of these patients are given in detail with special comment.

In conclusion the author maintains that roentgen irradiation is not superior to electrocauterization. One of his patients whose tuberculosis got worse after roentgen treatment showed improvement with electrocauterization; others showed improvement spontaneously after roentgen treatment was discontinued. The author supplies 19 references.

Acevedo Sojo [64] gives a short lecture on laryngeal tuberculosis occurring in the course of puberty. After some general observations on the physiology and endocrinology of adolescence, he observes that tuberculous laryngitis is infrequent in this age group and that it is just this unusualness that is responsible for many errors and delays of diagnosis. Furthermore, the vocal changes, including hoarseness, which are normally encountered in puberty may camouflage the early stage of tuberculosis of the larynx. The importance of systemic routine examination, with a roentgenogram of the chest being made, is stressed in conjunction with mass surveys, as well as an investigation of the family history, the social background and the occupational environment.

In this second paper, apparently devised for the same audience as the preceding one, Acevedo Sojo [65] briefly discusses the symptoms and the treatment of tuberculous laryngitis in rather brief and general terms. (We dispense with the abstraction of this article, which evidently was not intended for otolaryngologists or phthisiologists.)

Gad and de Linde [66] describe the procedure by which they demonstrate Koch bacilli by culture of laryngeal material. They use a modification of the technic described by Böhn and Ekstein, dipping sterile cotton swabs into sterile water, then approximating these to the larynx and having the patient cough three or four times, after which they place the swabs in sterile tubes.

64. Acevedo Sojo, J. T.: Laryngeal Tuberculosis and Puberty, Bol. san. Dep. nac. hig. Buenos Aires (supp.) **6**:695-698 (Dec.) 1942.

65. Acevedo Sojo, J. T.: Laryngopulmonary Tuberculosis in Adults, Bol. san. Dep. nac. hig. Buenos Aires (supp.) **6**:751-754 (Dec.) 1942.

66. Gad, U., and de Linde, B.: Demonstration of Tubercle Bacilli by Laryngeal Culture: Value of Method to Tuberculosis Dispensaries in Rural Districts, Acta tuberc. Scandinav. **18**:89-99, 1944.

The survey was conducted among dispensary patients with pulmonary tuberculosis who were without collapse treatment. Material was gained in the way described and cultured in 660 instances; in 348 the examination included, in addition, gastric lavage, and in 338, a study of sputum; 26 cases were checked by all three methods. Laryngoscopy revealed 10 cases of tuberculous laryngitis among 660 patients, and in each of the 10 cases culture of laryngeal material showed tubercle bacilli.

The authors summarized their observations as follows: In cases with open lesions culture of laryngeal material is less reliable than examination of sputum and gastric lavage; however, the fact that sometimes a positive laryngeal culture was obtained in cases in which gastric lavage revealed no tubercle bacilli shows that these exceptional cases are potentially infective, and this justifies the use of the accessory diagnostic method.

Rothstein and Pirkle [67] report a case of bilateral pulmonary tuberculosis with tuberculous laryngitis in which partial laryngeal obstruction developed, owing to fusion of the anterior ends of the vocal cords. After an attempt at bronchoscopy, extreme dyspnea and cyanosis developed and the patient collapsed. An emergency tracheotomy was performed to save the patient from immediate suffocation. The interesting features were that abundant sputum from the tracheotomy tube was removed by periodic suction and that bilateral pneumothorax treatment was successfully instituted while the tube was in situ. Under collapse therapy the patient's pulmonary tuberculosis became arrested, and while the authors' paper was being prepared for publication, surgical reconstruction of the larynx was being considered. This case illustrates the importance of tracheotomy both as a lifesaving procedure and as a supportive measure in the treatment of stenosing tuberculous laryngitis.

Schwartzman and Escutary [68] report on their experience with intravenous injection of Gillot's fluid to combat dysphagia in laryngopulmonary tuberculosis. The compound is a purified resin oil containing fenchyl and isofenchyl alcohol, cineol (eucalyptol), borneol (oil of hemlock), camphor and sesquiterpenes. It has good local bactericidal properties and has a definite analgesic effect which promoted its therapeutic trial in cases of tuberculous dysphagia. The authors report the technic and the dosage of the intravenous injections which were tried on 53 patients, 35 (70 per cent) of whom obtained from marked to complete relief from pain; 14 of the remaining ones failed to respond,

67. Rothstein, E., and Pirkle, H. B.: Tracheotomy for Tuberculous Laryngeal Stenosis, Am. Rev. Tuberc. **50**:176-178 (Aug.) 1944.

68. Schwartzman, J., and Escutary, J. M.: The Treatment of Dysphagia in Laryngopulmonary Tuberculosis with Gillot's Mixture, Semana méd. **2**:650-659 (Sept. 28) 1944.

while in 4 the results were doubtful. This treatment is considered the method of choice because of the large percentage of cases in which it gave symptomatic relief and because of its lack of toxicity, the simplicity of its application, which can be managed by the general practitioner if necessary, and the fact that it may be used even on patients who are in poor general condition. It is well understood that this treatment presents a palliative measure without any curative ambition.

Coté [69] relates that pharyngolaryngeal miliary tuberculosis was first described by Isambert seventy years ago. Although it most often appears as a form of laryngeal tuberculosis in childhood, at Laval Hospital it has occurred as a local manifestation in about 10 per cent of the patients with pleuropulmonary miliary tuberculosis. It has an acute course and usually involves first the oral pharynx, whence it extends to the larynx. It can be distinguished from the common laryngeal tuberculosis by the fact that its behavior is more insidious and that it has a predilection, at least in the beginning, for the glottis. Dysphagia, weakness, fatigue, loss of weight and cachexia are the cardinal symptoms. Diagnosis is often difficult because of the absence of functional signs, the frequency with which the sputum is bacillus free and the indefinite roentgenographic findings. The histories of 2 female patients are added in detail, in both of whom the disease terminated fatally.

Zinn [70] evaluates the symptomatic value of hoarseness and lists its most prominent causes as follows: (1) inflammatory disease; (2) trauma; (3) tumor (cancer of the larynx); (4) functional disturbance of neurologic disorders, both of the central and the peripheral nervous system. Tuberculous laryngitis secondary to pulmonary tuberculosis is briefly mentioned among conditions belonging to the inflammatory group. Conceding that only a small percentage of patients complaining of hoarseness show tuberculous laryngitis as its cause, the author points out that it is a fairly consistent and frequently an early symptom of moderately and far advanced laryngopulmonary tuberculosis and that its symptomatic significance therefore cannot be overemphasized. This article is of interest only to the general practitioner and has little to offer to the specialist.

Robin [71] reports on his experiences with "promin" (sodium p,p′-diaminodiphenylsulfone-N,N′-didextrose sulfonate) in the treatment of

69. Coté, G. L.: Pharyngo-Laryngeal Granulia, Laval méd. **9**:641-646 (Oct.) 1944.

70. Zinn, W. F.: Significance of Hoarseness, Ann. Otol., Rhin. & Laryng. **54**: 136-142 (March) 1945.

71. Robin, I. C.: Treatment of Tuberculous Laryngitis with Promin (Promamide), Tubercle **26**:186-189 (Nov.-Dec.) 1945.

laryngopulmonary tuberculosis. All his patients already had been treated with the traditional therapeutic methods without adequate results, and for about half of them the prognosis varied from grave to hopeless. The secondary laryngeal lesions were of the ulcerative and granulomatous type. There were a few hematogenous infections, but the majority were sputogenous, which is what one would expect.

The drug was used in a 20 per cent solution in glycerin. This solution was applied to the larynx one to three times daily. For proper evaluation, alternate groups of patients were treated with chaulmoogra oil, while others were put under preliminary observation of the effect of two to four weeks of silence and two daily inhalations of oil of pine needles. Altogether 28 patients were treated during a period of fifteen months. For all vocal rest was prescribed routinely, smoking prohibited and a bland diet provided, irritating foods being avoided. Their dental hygiene was carefully checked to eliminate oral infections and to exclude defects due to trauma. Among the patients with ulcerative laryngitis, 14 were treated with "promin" and 12 with chaulmoogra oil; 2 were changed from "promin" to chaulmoogra oil, and 2 were not treated with either drug because their tuberculosis was too hopelessly advanced. The average duration of treatment was three months. The results among 14 patients treated with "promin" showed marked improvement in 7, slight improvement in 2, no benefit in 3 and deterioration in 2. Among the 12 patients treated with chaulmoogra oil, 5 improved, 6 showed no change and 1 got worse.

The author concludes that there is no startling difference in the results obtained with "promin" and with chaulmoogra oil in patients with tuberculous laryngitis and that either drug might be tried until a more effective drug is found.

The decisive prognostic factor is still the course of the pulmonary disease, regardless of the topical chemotherapeutic agent used.

A report of 26 cases is included.

Humphries [72] presents an excellent clinical survey and statistical extraction of 139 cases of laryngeal tuberculosis covering a five year period of institutional work. This is one of the outstanding articles of our present review. Its essence lies in its statistical tabulations, and therefore it does not lend itself to abstraction. There are altogether 18 tables breaking down the case material in great detail and taking into consideration age, incidence according to sex, nature, localization, extent of laryngeal lesions and pulmonary involvement, type and results of treatment with special reference to the location and the number of cauterizations, sputum examinations on admission and discharge, col-

72. Humphries, M. K., Jr.: Laryngeal Tuberculosis, Dis. of Chest **12**:129-146 (March-April) 1946.

lapse measures and complications of the systemic disease, and finally comparison of this and two previous five year periods and a survey of the symptomatology.

The medical treatment consisted of physical rest and topical use of soothing sprays (paramonochlorophenol, guaiacol and menthol).

Finally there are an enumeration and an evaluation of surgical methods: (1) galvanocauterization, (2) laryngoscopy, (3) biopsy, (4) resection of the epiglottis, (5) block of the internal branch of the superior laryngeal nerve, (6) tracheotomy, (7) arytenoidectomy, (8) bronchoscopy, supplemented, if necessary, by aspiration, biopsy and cauterization, and (9) pulmonary collapse measures.

The objectives, as the author states in his summary, are to free the sputum of tubercle bacilli, control the pulmonary process, with relief of its symptoms, and rehabilitate the patient. For the busy practitioner who cannot take time off to analyze the statistics, we add the following digest copied from the author's own summary.

Group I consisted of 60 cases of incipient tuberculosis of the larynx. In these cases there was no edema or ulceration; 38.2 per cent were asymptomatic. The posterior commissure only was involved in 80 per cent of these cases. Examination of the chest revealed 8.4 per cent in the minimal group, 45 per cent moderately advanced, and 46.6 per cent far advanced. On admission 75 per cent had positive sputum and 11.6 per cent positive sputum on discharge. Some form of chest surgery was performed on 71.6 per cent. The treatment consisted of comforting sprays and silence. The results showed 78.3 per cent of the larynges healed or improved, and 76.6 per cent of the chests healed or improved.

The second group included 52 cases with slight edema and slight ulceration. Only 5.7 per cent were asymptomatic. The pathology in this more advanced group involved the posterior commissure per se in only 19.2 per cent of the patients; 98 per cent showed moderately or far advanced chest pathology; 88 per cent had positive sputum upon admission; 21 per cent had positive sputum on discharge; and 96 per cent had some form of chest surgery. The treatment, in addition to silence and spray, consisted of galvanocautery and nerve block. The larynx improved or healed in 73 per cent of the cases; the chest improved or became arrested in 55 per cent of the cases.

The third group included 27 patients with advanced edema and ulceration of the larynx. The symptoms were marked cough, hoarseness and pain in all cases. Far advanced chest disease was present in 82 per cent, and 92.5 per cent had positive sputum. The sputum was positive on admission in 92.5 per cent and positive on discharge in 14.8 per cent. The treatment of the larynx consisted of silence, sprays, cauterization (in 66.6 per cent) and tracheotomy (1 case). The larynx healed or improved in 33.3 per cent; the chest improved in 26 per cent.

The percentage of tuberculosis of the larynx has decreased greatly during the last few years. The likely reason for this is the increased rate of early diagnosis and the early institution of thoracic surgery to obtain negative sputums. These 139 cases of laryngeal tuberculosis represent an incidence of 6.2 per cent. This is 50 per cent less than in a similar group study 1933-1938. The study further shows that there is a gain of 24.6 per cent in the use of collapse therapy. Of these 139 cases, 73.9 per cent received some form of collapse therapy as against

49.3 per cent of a similar group study 1933-1938. The death rate of 28.8 indicates the seriousness of that disease in all cases of laryngeal involvement.

In his recent publication Myerson [73] reports on his experiences with insufflation of sulfanilamide powder in cases of tuberculous laryngitis. He stresses that secondary infection of a tuberculous ulcer is an important contributing factor in the causation of pain, and he found that by combating the secondary organisms and cleansing the ulcer he alleviated pain and dysphagia and so indirectly was able to give hopeless patients a chance to improve their nutritional and general condition by enabling them to swallow. He used the usual atomizer with adjustable tip and gave from 5 to 10 grains (0.32 to 0.65 Gm.) of sulfanilamide powder with each application. This method is not effective in cases of dysphagia caused by deep ulcers combined with perichondritis of one or both arytenoid cartilages. The treatment was tried on a series of 60 patients, and the frequent relief of pain warrants its further application and study.

Hulse [74] emphasizes the correlation between pulmonary and laryngeal tuberculosis. He maintains that the most accurate prognostic criterion is the result of allowing patients to subsist on simple rest alone, periodic clinical check-ups being made to determine their somatic response. Discussing various methods of treatment, he first mentions the now more or less abandoned use of menthol and chaulmoogra oil, which he considers therapeutically unsound and of psychologic value only. Chemical cauterization is of limited use only; shallow ulcers can occasionally be excised in well selected cases. The benefits of either method are of dubious value once a lesion has broken through the superficial membrane into the underlying tissue. Ultraviolet radiation is contraindicated for acutely exudative lesions and probably is of little value on account of the difficulties, in spite of the many ingenious devices to deliver the rays to the deeper-seated lesions; it should be regarded only as a supportive agent. High voltage roentgen rays are contraindicated in pulmonary tuberculosis and in acutely exudative laryngeal tuberculosis; they should be limited to the dry productive type of disease. They have no bactericidal value but do stimulate tissue response. With these limitations in mind, a therapeutic trial seems justified.

Electrocautery exerts its therapeutic effect through destruction of diseased tissue and stimulation of local regenerative processes. It should be used only when the body is able to wall off the infection. The importance of general and vocal rest cannot be overestimated.

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73. Myerson, M. C.: Sulfanilamide Spray for Pain in Tuberculous Laryngitis, J. A. M. A. **130**:1014-1015 (April 13) 1946.

74. Hulse, W. F.: Treatment of Tuberculosis of the Larynx: An Evaluation, Arch. Otolaryng. **43**:578-585 (June) 1946.

Silence combined with adequate pulmonary control is by far the cardinal feature in the treatment of laryngeal tuberculosis. Six case histories are briefly stated, from which Hulse concludes that the most important factor in the successful management of laryngeal tuberculosis is the control of the basic pulmonary disease, even if these patients do not rely entirely on pulmonary collapse for the total therapeutic support. The need for cohesive thought and action in the therapy of tuberculosis of the upper and lower respiratory tract is stressed.

Mumbert [75] insists on the importance of absolute rest; he deprecates any surgical intervention if the tuberculosis has appeared after the fifth month of pregnancy; he recommends massive doses of ascorbic acid and a vitamin K preparation; for dysphagia he recommends that a 1 per cent solution of procaine hydrochloride be injected into the superior laryngeal nerve.

LeLourd [76] practiced procaine hydrochloride infiltration of the carotid sinus in 16 cases of tuberculosis of the larynx with ulceration and intense pain. Good results were obtained in 15 patients with repeated injections of 20 cc. of procaine hydrochloride in 1:200 solution. The disappearance of the sinocarotid reflex (whether or not it is accompanied by Horner's syndrome) demonstrates sufficient infiltration. Pulsations transmitted to the needle demonstrate that the injection is made close to the blood vessel. Infiltration of both carotid sinuses may sometimes be required, although relief from pain is often accomplished almost immediately with unilateral infiltration. Primary ischemia may subside rapidly and be followed by secondary vasodilatation, which may still be manifest on the fifth day. As a rule, the effect of the infiltration lasts from five to ten days and not longer than twenty days. Infiltration may be repeated for months without losing its effectiveness. In 3 cases of LeLourd's series there was complete relief from pain with disappearance of the edema and cicatrization of the ulcerated area. Although the latter effect will not be obtained frequently, infiltration of the carotid sinus is an excellent method of treatment of tuberculosis of the larynx.

Auerbach [77] discusses the problem of laryngeal tuberculosis from the point of view of the pathologist. The survey, done in the department of pathology at Sea View Hospital, comprises 811 cases of tuberculosis which came to autopsy during a period of five and a half years; 37.5 per cent of the entire material showed laryngeal involvement, confirmed

75. Mumbert, V.: Author's Criterion in Tuberculosis of Pregnancy, Toko-ginec. pract. **4**:347-360 (Oct.) 1945; copied verbatim from Tuberculosis Index & Digest of Current Literature, London, March 1946, p. 59.

76. LeLourd, R.: Treatment of Tuberculosis of the Larynx with Procaine Hydrochloride Infiltration of Carotid Sinus, Presse méd. **53**:501-512 (Sept. 22) 1945; copied verbatim from J. A. M. A. **130**:180 (Jan. 19) 1946.

77. Auerbach, O.: Laryngeal Tuberculosis, Arch. Otolaryng. **44**:191-201 (Aug.) 1946.

by histologic examination. In opposition to many observers who described tuberculous laryngitis as a late complication of systemic tuberculosis, the author maintains that the syndrome occurs most frequently in patients who die of pulmonary tuberculosis of a duration of from one to two years. The majority of cases were encountered in the third and fourth decennium. It is rarely found in children, who usually show a primary complex or hematogenous disease; however, juvenile patients who have open pulmonary tuberculosis with cavitation show the same percentage of laryngeal involvement as adults. The breakdown of the autopsy material according to sex showed twice as many males as females, a ratio which corresponded to that of the general necropsy series; the racial disposition also showed a direct proportion between the percentage of tuberculous laryngitis and that of death of systemic tuberculosis. It is interesting to note, however, that the patients with laryngeal involvement showed a higher incidence of tracheobronchial and gastrointestinal tuberculosis than the general autopsy series.

As far as the pathogenesis is concerned, sputogenous infection had to be accepted for the vast majority of cases, while only 2 patients of the entire group showed hematogenous spread.

The second half of the paper is dedicated to the morbid anatomy of laryngeal tuberculosis, with the main emphasis on the gross and the microscopic appearance of the tuberculous ulcer. The most common localizations, in order of frequency, are the true vocal cords (47.1 per cent), the epiglottis (39.4 per cent) and the false cords (29.2 per cent); the entire surface of the larynx was involved in 14.2 per cent. The tuberculous ulcer of the larynx develops either through compression atrophy of the mucous membrane by progressive enlargement of the subepithelial foci or through caseous necrosis of the mucous membrane. Both phases are pictured in detail, this being followed by a description of the further development of the ulcer, which might tend toward either progression or healing.

Abstracts from Current Literature

Ear

TESTS FOR SELECTION OF HEARING AIDS. RAYMOND CARHART, Laryngoscope **56:** 780 (Dec.) 1946.

One cannot assume that the selection of the hearing aid which is best suited to a person can be made by audiometric tests. The person needs the aid primarily for the reception of speech in everyday situations. Fitting tests must be designed to satisfy such conditions and also to deal with persons presenting special problems. One must determine several things: effective gain, tolerance limit, efficiency in the presence of background noise, and efficiency in distinguishing small differences of sound.

The tests described are those used at the Deshon General Hospital, Butler, Pa. Speech was the stimulus used throughout. There were tests for each of the criteria mentioned in the foregoing paragraph. The tests are described in detail. They are simply performed and are not time consuming. They have proved to be "clinically effective in differentiating among hearing aids" and in defining the special problems faced in unusual cases.

HITSCHLER, Philadelphia.

THE TREATMENT OF SUPPURATIVE APICITIS. ANDERS THORNVAL, Acta oto-laryng. **34:**546 (Nov.-Dec.) 1946.

Abscess of the apex of the petrous bone does not occur often but must be evacuated when it does. The first to describe a method of reaching such an abscess was Streit (1903). He made an entrance into the apex by way of the superior anterior surface of the pyramid after first lifting up the dura of the middle fossa. In the thirties Eagleton employed a modified Streit approach. Ramadier and Almour began by doing a detailed type of radical mastoidectomy after which Ramadier made a way to the apex by resecting part of the wall of the carotid canal, whereas Almour drilled a way in between the cochlea and the carotid canal. Frenkner uncovered the three semicircular canals and proved that one could often find a way into the apex through the finely meshed cell system of the superior portion of the vertical semicircular canal.

Thornval bases his conclusions on 3 cases, which he describes in detail. He directs attention to the need of extensive roentgen studies, including the petrous apex, of every patient with suppuration of an ear. He advises first searching for draining cell tracts before more extensive surgical work is undertaken. He attempts to find existing cell tracts through which pus is being evacuated, after he has performed radical mastoidectomy. In 1 case he then attempted Ramadier's operation, which he found rather difficult of performance. In his third case he practiced the procedure originally designed by Streit by doing a rather extensive removal of the squama and lifting the brain of the middle fossa from the surface of the anterosuperior aspect of the petrous bone. No pus was encountered, but at one point near the apex the color of the bony cortex appeared abnormal. At this point the cortex was broken through with a curved chisel and a large amount of pus evacuated. A gauze drain was inserted, which was removed in two weeks and then reinserted for another three and one-half weeks. The patient was released from the hospital eighty days after admission and had made a good recovery.

Thornval believes that if this approach of Streit's is contemplated, radical mastoidectomy does not need to precede it. Simple mastoidectomy should be sufficient. An area of squama about 2 by 2.5 cm. was removed. The brain was lifted with two narrow brain spatulas, and as an additional aid he employed a half-length Killian nasal speculum. There was ample room to perforate the bone with a curved chisel just lateral to the gasserian ganglion. This perforation was

enlarged with rongeurs and the abscess cavity cleansed by suction. The drain was kept in for five and one-half weeks, but Thornval thinks this may have been too long.

In doing this operation more working space can be obtained by making a subpressure lumbar puncture as recommended by Brünnings. Brünnings has stated that he has not seen any untoward effects in more than 100 cases in which the cerebrospinal fluid was completely drained.

Thornval states that his procedure, which he calls a modified Streit operation, was criticized by O. Mayer, Unterberger, Tobeck and Kopetzky for the reasons that it might encourage a dural lesion, that there might be incomplete drainage and that it might result in damage being done to the great superficial petrosal nerve.

GROVE, Milwaukee.

Pharynx

PERITONSILLAR ABSCESS AND MEDIASTINITIS. NILS G. RICHTNER, Acta oto-laryng. **34**:521 (Nov.-Dec.) 1946.

A 57 year old man complained of sore throat and fever. He had been under sulfathiazole treatment. He presented a pronounced right peritonsillar abscess. Incision evacuated a foul-smelling pus. Sulfathiazole medication was continued. Later the same day he complained of severe pain in the epigastrium. As he had had no bowel movements for a week, he was given an enema, with good results. The epigastric pain, however, increased, and he complained of distention. On examination there was some dyspnea as well as epigastric tenderness. The blood pressure was normal; the lungs clear. The white blood cell count was 18,300. The urine showed albumin. Roentgen examination revealed mottled areas behind the heart on the left side. The patient became worse, and rigidity of muscles developed in the lower part of the abdomen, which previously had been soft. A perforated ulcer was suspected, and laparotomy was done. No pathologic condition was found in the abdomen. A roentgenogram of the lungs now showed bronchopneumonia involving both bases. A blood transfusion was given, but the patient became rapidly worse and died forty-eight hours after hospitalization.

Autopsy disclosed acute peritonsillitis, acute purulent mediastinitis, serofibrinous purulent pleurisy on both sides and acute pericarditis. The throat was particularly interesting. In place of the right tonsil there was a discolored, ragged opening leading into the peritonsillar tissue to a plum-sized abscess, which was distributed through the connective tissue into small areas. From this abscess a purulent tract extended along the carotid artery and the jugular vein. At the lower level of the larynx this purulent tract changed into an area of diffuse phlegmonous infiltration going into the mediastinal connective tissue. Here and there were localized abscesses. The phlegmonous infiltration ceased at the diaphragm.

It is not difficult to understand that retropharyngeal abscesses may cause mediastinitis. The retropharyngeal space communicates directly with the prevertebral space, which constitutes a part of the posterior mediastinum. The prognosis in these cases is extremely grave. Glogan described, in 1923, 6 cases of retropharyngeal abscess complicated by posterior mediastinitis in which recovery occurred after incision of the retropharyngeal abscess and collar mediastinotomy.

However, in cases in which mediastinitis has originated in the tonsillar region it has been more fulminating and malignant than in the retropharyngeal cases with like complications. The peritonsillar abscess spreads through the constrictor muscle into the parapharyngeal space. This space stretches from the base of the skull to the mediastinum, and in this space lie the great vessels of the neck. The evidence that a peritonsillar abscess has spread to the pharyngomaxillary space is that the swelling of the neck does not subside after the incision of the peritonsillar abscess. Nor does the cervical lymphadenitis subside. The infection may spread from the parapharyngeal space to the anterior mediastinum.

In the literature of the past twenty years, Richtner has found 13 cases of mediastinal abscess originating in infection of the tonsillar region. Only 4 of the patients recovered. In the 9 patients who died the disease followed a very acute

course, and drainage of the mediastinum did not help. Richtner says that the diagnosis of mediastinitis should not be difficult in such cases. (It is interesting to note that it was missed in the case which he reports.) The patients have dyspnea, are slightly cyanotic, complain of pain in the back and show tenderness to palpation and percussion above the sternum. There is also tenderness along the sheath of the great vessels. The sedimentation rate is high. The roentgenogram is an excellent accessory. An appreciable widening of the mediastinum to the rear at the left can be made out. Subsequent roentgenograms will show an increase in this widening. The treatment should consist of tonsillectomy and collar mediastinotomy together with intensive antibiotic medication.

GROVE, Milwaukee.

Larynx

ORGANIZATIONS OF LARYNGECTOMIZED PATIENTS. J. A. M. A. **133**:146 (Jan. 11) 1947.

TO THE EDITOR: I understand that there is a "Lost Chord Society," membership in which is based solely on successfully undergoing a laryngectomy. Where are the headquarters of this society and who are its officers? Where can a patient who has had a laryngectomy receive information on artificial voice aids?

M.D., California.

Answer.—The Lost Chord Society has not been identified. The Anamilo Club of New York, which was organized at the National Hospital for Speech Disorders, is composed of persons who have had the larynx removed. At the suggestion of the attending surgeon a special committee of the club calls on patients who contemplate this type of operation. Artificial larynxes are manufactured by Otto Roberts, 705 Spivey Building, St. Louis, and by the Illinois Telephone Company. Information can be obtained from Mrs. Tillie Brinkman, 505 West Belmont Avenue, Chicago.

GORDON, Philadelphia.

VOICE CHANGES IN MALE ADOLESCENTS. E. THAYER CURRY, Laryngoscope **56**: 795 (Dec.) 1946.

The changes of voice occurring in male adolescents are discussed with particular reference to (1) the perceptual characteristics, (2) the age at which the changes begin, (3) the anatomic, physiologic and acoustic bases of the changes and (4) the theories regarding the changes.

Numerous writers' opinions are included in the discussion of the points mentioned. An extended bibliography, not previously published, is added.

HITSCHLER, Philadelphia.

SARCOMA OF THE TRACHEA. LOUIS FABRE, Ann. d'oto-laryng. **12**:477 (Oct.-Dec.) 1945.

The case presented was that of a man 60 years of age with sarcoma of the trachea. Under direct laryngoscopy the tumor was completely extirpated with biting forceps. After a period of three years there was no evidence of recurrence or of metastasis.

This paper consists mainly of a review of the literature with regard to this subject.

VIOLÉ, Los Angeles.

Nose

CHRONIC NASAL OBSTRUCTION. E. A. THACKER, J. A. M. A. **131**:1039 (July 27) 1946.

Thacker discusses chronic nasal obstruction, reviewing anatomic deformities (congenital or acquired), growths, chronic inflammatory lesions and vasomotor rhinitis in relation to constitutional states, after which he details the causes, the

effects and the methods of treatment of such conditions, taking in the vast subject of allergy. There are many references to the latter.

The review of cases of allergic obstruction revealed about one-half due to both inhalants and ingestants, approximately one-fourth due to inhalants alone and a like proportion due to foods alone. Nasal smears positive for eosinophilia are diagnostic of allergy, but a smear showing no eosinophils does not rule out allergy. The time element is important, for the degree of sinal involvement is roughly proportional to the length of time the allergy has existed. If all the paranasal sinuses are hazy to transillumination and roentgen rays, this may be diagnostic of existing allergy. If cloudiness is seen in one sinus or a unilateral group, it is most certainly on an infective basis. Children with allergy have a tendency toward hypertrophy of tonsils and adenoid masses. Obstructions should be removed, allergens diagnosed and eliminated when possible, and desensitization carried out. The results observed following the instillation of approved nasal drops, the internal use of theophylline ethylenediamine (3 grains [0.10 Gm.]), the administration of "nadin" (a water-soluble iodine preparation), which gives temporary relief from associated asthma and the taking of "benadryl" (beta dimethylaminoethyl benzohydryl ether hydrochloride) in 50 mg. capsules for temporary relief of nasal congestion in vasomotor and perennial allergic rhinitis have been somewhat encouraging. Conservative surgical treatment of the nose and control of allergy will help as stated, also injection of sclerosing agents into the turbinates. Nonspecific desensitization with histamine derivative was not found effective.

GORDON, Philadelphia.

ROUND SHADOWS IN THE MAXILLARY SINUSES. R. WESLEY WRIGHT, Laryngoscope **56**:455 (Aug.) 1946.

Wright makes a thorough and comprehensive study of the round shadow seen in roentgenograms of maxillary sinuses. Of 1,600 roentgenograms, about 5 per cent showed these shadows. Although many and varied associated symptoms have been previously reported, Wright found few symptoms except those directly attributable to local pressure, fulness, pain and numbness.

Round shadows may be due to nonsecreting cysts, secreting cysts or polyps. Inasmuch as the three types all show the same roentgenographic appearance the differential diagnosis is mostly made at operation. Seventy-eight cases are presented.

Treatment consists in surgical removal, as a cyst will usually recur if merely punctured. However, the cyst may be left alone if the symptoms do not warrant removal.

The nonsecreting cysts are the most common. They are thin-walled and of varying size, and contain a clear orange-colored fluid. They rupture easily and are removed intact only with difficulty. They are formed by distention of one or more of the areolar spaces in the subepithelial tissue. The distending fluid is similar to a transudate. The histologic, bacteriologic and biochemical aspects are discussed.

The secreting cysts are formed by the distention of mucous glands of the mucosa of the sinus. They may be due to repeated infections of the sinus. There is epithelium on the inside as well as on the outside of the secreting cyst. Secondary cysts may form, due to pressure on adjacent ducts.

Antral polyps are similar to nasal polyps.

HITSCHLER, Philadelphia.

Miscellaneous

A BRIEF REVIEW OF RHEUMATIC FEVER: THE ROLE OF TONSILLITIS IN ITS ETIOLOGY. DAVID HIGBEE, Ann. Otol., Rhin. & Laryng. **55**:227 (June) 1946.

Otolaryngologists may be the first to see rheumatic fever in its early stages because of the fact that an acute infection of the upper respiratory tract so often precedes the onset. Ninety per cent of the persons in whom rheumatic fever occurs

are under the age of 15. In persons between 10 and 15 the mortality from rheumatic fever is higher than that from any other disease. Each year in the United States, approximately 170,000 new cases develop. Owing to the tendency of rheumatic fever to become chronic and to produce cardiac involvement, 840 of each 100,000 of the population are afflicted with rheumatic heart disease. A number of factors are involved in the development of rheumatic fever: The hemolytic streptococcus, particularly group A, is almost universally present in the nose, the pharynx or the tonsils; frequently it has been cultured during the month preceding the first symptoms and generally is present during the initial attack. Only a small percentage of persons with positive cultures contract rheumatic fever; so other factors are emphasized. Climate may not play as great a part as was formerly thought. Heredity plays a strong role. Various points seem to indicate that allergy is an important factor.

In more than 50 per cent of cases the evidence of rheumatic disease is preceded by an infection of the upper respiratory tract. The onset of rheumatic fever in children may be so obscure that only a succession of minor events make one suspicious. Among the earliest common symptoms are fatigue, failure to gain weight, growing pains, night sweats, recurrent low grade fever, muscular soreness and general irritability. There may be leukocytosis and a high erythrocyte sedimentation rate. More advanced stages are recognized by fever, polyarthritis, tachycardia, pallor, profuse sweating and the appearance of general illness.

The author feels that it is of the greatest importance that tonsillectomy be performed before the first attack and that after rheumatic fever is established, the value of the operation is questionable. In the presence of a strong hereditary tendency, he feels that the removal of apparently normal tonsils is justified.

M. V. Miller, Philadelphia.

National Survey of State Legislative Provisions for the Speech Defective Child in the Public School. Frances Welborn Fesler, Quart. J. Speech **32**:349, 1946.

A letter was sent to the director of each state department of education and to the supervisor of schools in Washington, D. C., asking for information concerning legislation enacted for the education of children whose speech is defective. Six and one-tenth per cent of the states and the District of Columbia reported specific legislative provision for speech rehabilitation in public schools. Sixteen and three-tenths per cent, representing 22 per cent of the total school population, have included the child with defective speech among the types of handicapped children to receive special education in the public schools. In another 16.3 per cent of the states, comprising 17.3 of the total school population, children defective in speech are not mentioned in legislative provisions but are included in the program for handicapped children. In 10.2 per cent, representing 9.2 per cent of the total school population, programs have been proposed or considered. In about 50 per cent of the states, comprising 46 per cent of the total school population, no programs, provisions or proposed legislation have been mentioned. Sixty-one per cent of the states have no programs or formal provisions for programs at the present time. Thirty-nine per cent of the states were taking care of their children by specifically including the child defective in speech in the laws regarding handicapped children or by liberally interpreting such laws.

Palmer, Wichita, Kan.

The Selection and Training of Battle Telephone Talkers. John C. Snidecor and Louis A. Mallory, Quart. J. Speech **32**:367, 1946.

This is a report on the research of the Office of Scientific Research and Development begun in 1942 at the request of the Navy to determine the most intelligible battle telephone talkers. An interview which could be given over the telephone was developed, together with a rating sheet. This interview was used in selecting and classifying over 2,000 men. At least two judges interviewed each man over

a low fidelity phone system, and each rated him independently of the other. Of the men interviewed, 419 were also tested by representatives of the psycho-acoustic laboratory of Harvard University, for their ability to listen in noise and for their ability to remember digits. The findings were as follows:

1. The speech ratings fell into an essentially normal distribution.

2. It was found practical to give a speech rating to every enlisted crew member during the normal assembly and classification of a ship's crew.

3. Sea experience, telephone talking experience (at sea) and education were found to be not closely related to speaking ability as measured by this method.

4. The speech traits most often associated with poor intelligibility were: poor articulation, foreign or regional dialect, loudness factors and voice quality factors.

5. Those speaking the general American dialect were more intelligible than those speaking the Southern or the New England dialect.

6. Expert judges agreed closely in evaluating intelligibility and descriptive fluency.

7. Expert judges agreed more than 90 per cent of the time in placing a given man in one of the three categories of well qualified, qualified or disqualified.

8. Speaking ability is not highly related to memory span or to listening ability.

The article continues with a discussion of training methods, mass drill, loudness, promptings, skilled speech instruction and dramatic recordings, criticism and discussion. Groups of experimentally trained men were retested after twenty-four hour periods. Without exception, the average scores showed improvement. It was found that listening to one of the training records, "How to Speak Over Battle Phones," produced a statistically significant improvement in intelligibility. Training aids were developed to implement the talker training program: The "U. S. Fleet Telephone Talker's Manual," "A Supplement to Fleet Telephone Talkers' Manual" and the "Battle Telephone Talker" (all restricted publications) were used.

PALMER, Wichita, Kan.

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Francis L. Lederer, M.D., *President*

Walter H. Theobald, M.D., *Secretary*

Regular Monthly Meeting, Feb. 3, 1947

Effect of Obliteration of the Endolymphatic Sac and Duct in the Monkey.
Presented by Dr. John R. Lindsay.

This article was published in full in the Archives of Otolaryngology (**45**:1 [Jan.] 1947).

DISCUSSION

Dr. Barry J. Anson: From Dr. Lindsay's series of 7 ears operated on, it would appear that in at least 2 all portions of the endolymphatic duct and sac had been successfully destroyed without concomitant disturbing damage being done to other parts of the otic duct system.

The portions which were experimentally destroyed are, as Dr. Lindsay has pointed out, those which physicians have come to regard as chiefly functional in maintaining a normal quantity of endolymph within the system of continuous labyrinthic epithelial tubes. By the same token, one would have expected to learn that, as a result of ablation, hydrops of the labyrinth had occurred.

Dr. Guild's study was experimental; his conclusions were based on the observation that injected dyes were deposited (a suitable time after being introduced into the otic system) in the walls of the specialized portions of the endolymphatic duct. The conclusions drawn by Wilson and myself were based wholly on microscopic examination of sectioned material; we believed that the histologic structure of the duct and sac met the requirements of a resorptive mechanism (illustrated by lantern slides); the epithelial walls were plicate, the subjacent tissue vascular. Recently this opinion has been strengthened by reconstructions, prepared by Dr. T. H. Bast, of the endolymphatic duct and sac and of their blood vessels as found in human fetuses. The endolymphatic sac was shown to be relatively very large, its walls proximally folded to a striking degree; plexiform veins were traced to meningeal and associated veins.

Now I am perplexed, being beset by seemingly contradictory evidence. Several feeble ways of escaping from this dilemma may be offered by the following possibilities:

(1) That there may be other, ordinarily auxiliary, ways of passage for the endolymph (by way of the dilated proximal portion of the duct, or by way of the cochlear aqueduct, across periotic tissue into haversian vessels).

(2) That hydrops is an extreme condition, dependent on disturbance more profound and extensive than that produced by Dr. Lindsay's experimental ablation.

(3) That the normal "reclamation" of endolymph is slower than investigators have supposed—and capable of being managed, for a time, by a process of transudation across other parts of the labyrinthic system into surrounding spaces and tissues.

Were any one of these possibilities to find support in later studies, our concept would merely need modification. But, for the present, I wish to record my admiration of Dr. Lindsay's investigation and my recognition of the great value of such experimental methods. They come closest to permitting actual observation of the mechanisms in action.

DR. JOHN R. LINDSAY: Dr. Shapiro asked whether studies of hearing were made. There were none, and no estimation could be made relative to hearing. These were all monkey experiments, and conditioning to sound was not attempted. No nystagmus was seen after operation. There was no deviation of the eyes when pressure was applied over the ear after operation such as that which may be produced after fenestration. On the following morning the animals were running around as actively as before operation, and no nystagmus or disturbance of equilibrium was observed.

I want to thank Dr. Anson for his discussion. While the information obtained in the experiments is limited, it is of practical interest from the standpoint of the pathogenesis of labyrinthine hydrops.

Changing Concepts of Therapy of Chronic Sinusitis. Presented by DR. LAWRENCE J. LAWSON.

Intumescence of functional type complicates the treatment of chronic suppurative sinusitis. Mucous membranes have hypoactivity and hyperactivity rates of mucus production. States of chronic hyperrhinitis play an important part in the production of chronic suppurative sinus disease. An understanding of them is necessary for successful therapy. Changing concepts of therapy have resulted from (1) a broader understanding of the factors producing functional types of rhinitis, (2) continued contributions to knowledge of nasal function, (3) practical applications of endocrinology to rhinologic practice, (4) successful clinical management of nonseasonal allergic rhinitis and (5) excellent studies in the fields of surgical anatomy and histopathology, which have helped to make surgical treatment more effective.

Conservative therapy is stressed because much can be done by correcting systemic disturbances and treating nonseasonal allergic states by the very successful desensitization methods. Because present knowledge is still limited, some patients will resist all conservative therapy. Three types of less conservative local therapy are mentioned, because allergic nasal conditions can be difficult problems. These are: the applying of a galvanic current to an electrolyte in the nose, electrocoagulation with the bipolar nasal electrode and use of sclerosing solutions.

Antral infections of dental origin are more destructive than other types. They interfere with the normal defensive mechanisms of the mucous membrane by first invading the subepithelial stroma.

When surgical intervention is necessary antral windows that are large and smooth and least disturbing to nasal function are highly successful. The Caldwell-Luc operation is reserved for tumor of the antrum, dental cysts of the base, osteomyelitis and certain traumas requiring direct inspection.

Adequate channels of drainage are to be restored and maintained with the least possible damage being done to functioning nasal and sinal mucosa and bony structure.

DISCUSSION

DR. O. E. VAN ALYEA: Dr. Lawson has given an admirable presentation of many facts concerning the nose and the sinuses as these are known today. It is a broad subject that cannot be covered in a single paper. However, he has given his solutions of many important problems encountered daily in rhinologic practice. The main points of his paper might be summed up as follows:

1. A rhinologist must, primarily, be a good physician. He should have a working knowledge of endocrinoiogy and allergy, and he should manage the desensitization of his allergic patients personally.

2. He should not overlook the possibility of functional disorders being a cause of symptoms referred to the nose. He should treat each patient as presenting an individual problem rather than as one of a group who complain of symptoms thought to be due to sinal disorders.

3. The management of chronic sinusitis depends on the establishment of adequate facilities for drainage.

Last, functioning structures of the nose and the sinuses should not be subjected to mutilating and destructive surgical procedures; this includes the lining membranes of the sinuses.

I agree absolutely with him on all these points and might add that rhinology practiced properly calls for adherence to all the principles contained therein.

Dr. Lawson mentions the middle meatal approach to the maxillary sinus, but is not convinced that it is the one of choice. I assume that he has not been using it long, for I have noticed that the longer one uses this approach, the more satisfactory one finds it and the less likely is one to resort to bony puncture of the inferior meatal wall. I find that I use an available opening in two thirds of the cases and that in the remaining one third I puncture through the membranous wall of the middle meatus. So far, no untoward effects have been associated with this technic, and patients as a whole are pleased that they do not have to submit to a crushing, forceful, head-jarring procedure.

It is true that manipulations about the ostium injure the ciliated mucosa, but this recovers rapidly and the antrum heals as quickly as that irrigated through some other area. The assumption is that the procedure should be carried out gently.

There are patients in whom long-standing sinusitis fails to heal because, as Dr. Lawson says, drainage is inadequate. In a large number of these the condition will respond to conservative measures. The infection will clear up when improvement of the drainage facilities reaches the point that secretions leave the sinus as rapidly as they form. In certain patients the ostium is so constricted by thickened tissue that another opening is required. It has been noted that following intranasal antrostomy the lining membrane of the sinus has a tendency to return to a normal state. This fact, plus the success of conservative measures, has practically eliminated the need of the radical procedures and, as Dr. Lawson says, the Caldwell-Luc approach is reserved for those conditions requiring direct inspection for treatment of a new growth, cysts, osteomyelitis or fractures of the sinus walls.

There is a strong plea in Dr. Lawson's paper for a better understanding of nasal and sinal conditions and for their management by nonsurgical measures when, after careful study, these are shown to be properly indicated. I think one may well apply to this paper the remark made by that good friend William McNally, of Montreal, who feels, regarding the nose and the sinuses, that rhinologists should "try to understand, but what they don't understand they shouldn't destroy."

Dr. John J. Ballenger: I should like to ask whether Dr. Lawson knows of any effect that dust or any other type of allergen would have on ciliary activity.

Dr. Robert Lewy: I should like to have Dr. Lawson's opinion as to how frequently the maxillary sinus should be irrigated if pus is found in it.

Dr. George Shambaugh: I think Dr. Lawson's paper is timely, for there is a lot of confusion among physicians in general, even among laryngologists, as to what sinus infection is. In the literature one finds descriptions of sinusitis with no facts cited to prove that it was present. One knows from observation that most patients who say that they have a "sinus" do not have sinusitis. I think physicians should clearly differentiate rhinitis, with reaction in the nose but without retained secretion, from sinusitis with retained secretion; in cases of the latter the diagnosis of sinusitis is in order. I think most cases of intumescent rhinitis, hypertrophic rhinitis and catarrhal rhinitis are cases of allergy.

I have been one of Hansel's students for years. He has contributed the minute dose therapy for allergy, especially for dust allergy; as time goes on the dosage has become smaller. He has now, and I have also, cut the dose in some cases to a dilution of 1:1,000,000,000, which sounds extraordinary. There are actually patients who are so sensitive that they require a dilution as great as that. Dr. Hansel no longer tries to build patients up to the highest dose; he finds the optimum dose and stops there. If there is a clinical response, he stops at that dose and carries the patient on a maintenance dose. This small dose therapy, which is not accepted by most allergists, I think will prove to be one of his greatest contributions to this work.

DR. FRANCIS L. LEDERER: I have been worried about the nomenclature for years. Physicians speak of symptoms to describe an entity; then they use the term "basic etiology," and one wonders whether they are talking about basic pathology or histology. I am referring to the term "intumescent"—perhaps Dr. Shambaugh is right in thinking that in the majority of cases these "intumescent" tissues manifest allergic processes.

DR. G. H. MUNDT: I have lived through the period of the conception of the cause of sinus disease, as have many men here. I believe that pneumatization of the sinuses tells a great deal about the prognosis. Some physicians think that every patient who comes with a complaint of drip in the throat has a sinus infection. If one rules out a definite defect of mucous membrane or sinus, one can probably reassure the patient that he does not have sinus infection. I wish I might be as certain as some physicians are when to wash through the normal ostium and when to make an opening under the inferior turbinate. Some pass the irrigating cannula through the normal ostium, others through the inferior meatus, and apparently the results are about the same. It has been my experience, however, that if a sinus is much infected, better results are obtained by flushing through the inferior meatus. A patient who has definite osteomyelitis or a nonsecreting cyst or a polyp in the maxillary sinus might just as well have a Caldwell-Luc procedure at the start, rather than wait for months; I doubt that any patient of that type will get well without this simple procedure. Some of the most successful cases I have observed are those in which this was done.

I believe that in the last five years I have seen more patients with infection of the maxillary sinus following extraction of teeth than in previous years. Otolaryngologists should try to teach men who are doing exodontia that the patients should be taken care of at once and that an effort should be made to close any opening into the maxillary sinus as soon as the tooth is extracted; the results of neglect are disastrous in some cases. Occasionally such an opening will close under good management without the Caldwell-Luc procedure, but some weeks later the sinus may be full of pus. I am satisfied that many of them have osteomyelitic openings that will not close up under local treatment.

DR. LAWRENCE J. LAWSON: Dr. Van Alyea has had a great deal of experience in teaching this subject and has done much work in the laboratory. I appreciate his contribution.

In regard to Dr. Ballenger's question, I think he should wait until Dr. Proetz is here and bring it up again; Dr. Proetz will know something about it. Dr. Lewy asked about the frequency of irrigation. I think that every otolaryngologist has had experience with patients who have interrupted treatment to go away. When they report back the antrum has cleared. One should not start irrigations until one is sure that the infection will not clear spontaneously. Irrigations given at the rate of one every third day give excellent therapeutic response.

I was glad to hear Dr. Shambaugh say that one should not give high doses for allergic rhinitis, but the smallest maximum dose that will maintain good results. One controversial subject was mentioned—whether the apparent hypertrophy one sometimes sees is actual increase of tissue or just intumescence. I think that subject requires further study.

Lymphosarcoma of the Tonsil: Report of a Case. Presented by Dr. S. M. MORWITZ.

The summary of this paper was as follows:

1. Lymphosarcoma of the tonsil is not common and is exceptionally rare in children. Few cases are recorded in the literature.

2. The classification of malignant tonsillar tumors is briefly reviewed.

3. Examination of the whole tonsil is essential to assure correctness of the diagnosis. Repeated biopsies may be required.

4. Lymphosarcoma is known to be radiosensitive. The prognosis is poor. Although the tumor may disappear and a hopeful prognosis appear justified, the patient succumbs later to distant metastases. Before roentgen irradiation of the throat is started, the abdomen and the chest should be examined clinically and roentgenologically for metastases.

5. A case of lymphosarcoma of the tonsil of a 3 year old boy with a rapid fatal outcome is reported. Roentgen therapy failed to influence the lymphosarcoma in this child or in the children whose cases have been recorded in the literature. In all cases recorded in which the patients were children they were boys.

DISCUSSION

DR. ALFRED LEWY: I should have looked up this case in preparation for the discussion, but will relate it as nearly as I can. The patient was a woman in the 50's and complained of deafness, for which she had been treated by inflation, which gave temporary relief. She had a postnasal discharge, at times bloody. I found a tumor with superficial ulceration in the nasopharynx, biopsy of which showed lymphoepithelioma, and she was referred to the tumor clinic for irradiation. Involvement of the cervical glands was questionable; I thought I did palpate some glands, but they were not hard and were freely movable; these glands were included in the irradiation. Within six or eight months there was no tumor to be seen in the nasopharynx; there was some scarring covered by intact mucosa. However, as a result of irradiation, suppuration of the middle ear and external canal developed with more or less distortion of the auricle and some superficial lesions of the skin around the ear. This yielded to local treatment.

This woman lived for more than two years, during which interval one cervical gland enlarged. No biopsy was made, but the node was irradiated and reduced in size. The patient died of pneumonia; a roentgenogram of the lung taken one month before the pneumonia developed was said to be negative for any appearance of cancer of the lung. I did not see the roentgenogram.

DR. FRANCIS L. LEDERER: Drs. Holinger and Rigby reported a case of sarcoma of the larynx of an infant, but this is the first case that I have known of in the clinic in which such a tumor occurred in one so young.

Book Reviews

Intracranial Complications of Ear, Nose and Throat Infections. By Hans Brunner, M.D. Price $6.75. Pp. 432. Chicago: Year Book Publishers, Inc., 1946.

This monograph is an excellent review of practically all intracranial complications occurring in connection with infections of the ears, the nose or the throat.

The etiology, the pathology, the pathogenesis and the therapeutics are gone into in great detail, many obscure points being really cleared up. In addition, the work is a great refresher. The case reports are forthright and concise, with no attempt to conceal errors of judgment or poor results. The pros and cons for deciding whether or not to operate in these serious conditions are presented with fine deductive reasoning based on good underlying principles of anatomy and physiology.

So many important findings in the various complications are presented that it is impossible to read this monograph in a hurry. In fact, there is so much of the author's vast experience packed into its pages that one may well take several weeks for its complete perusal and study.

The antibiotic drugs have not been given too much prominence, and streptomycin in particular is hardly mentioned. Some of the poor results quoted could be improved on with more intensive antibiotic therapy. Patients with cerebellar abscess in the hands of other men, viz., those at the University of Pennsylvania, fare much better than is suggested by the authors "85 to 100 per cent mortality."

The graduate student as well as the experienced otolaryngologic surgeon would profit by adding this book to his library.

Applied Anatomy of the Head and Neck. By Harry Shapiro, D.M.D. Second edition. Philadelphia: J. B. Lippincott Company, 1947.

This is a book of about 300 pages containing over 200 drawings and photographs on applied anatomy of the head and neck, principally written for students and practitioners of dentistry. Its aim is to point out the important anatomic structures a knowledge of which can be clinically applied. This is adequately and admirably accomplished. While the work is not intended to be descriptive anatomy, the descriptions are clear and orderly.

A varied number of topics are effectively considered, such as roentgenography of the skull. In the presentation of this subject photographs of the skull in various positions are placed side by side with the roentgenograms and the latter are interpreted. Fascial planes of the neck, prosthesis, anesthesia, action of pharyngeal muscles, sinuses and their injuries, palpations of the mouth for structures and the temporomandibular joint are all clearly considered. While the book is written for dentists, there is much in it of value to the otolaryngologist. Much material is included which would be sought in many books and articles; in this book the otolaryngologist can find it clearly defined and illustrated.

Clinical Allergy. By Alexander Sterling, M.D., assisted by Bea Sterling Lollander. Price $5. Pp. 198, with 16 plates. New York: International Universities Press, 1947.

This monograph on allergy should be a great help to physicians who are in general practice. It avoids profuse academic discussions and gets right down to cases. Apparently treatment, with relief or cure, is merely a matter of tracking down the offending allergen or the combination of allergens. Most physicians are not so optimistic about the results of allergic study and therapy.

As to making up solutions accurately, sterilizing multiple bottles, having the patients come in daily for many months or years, this is certainly beyond the scope of the average physician whose practice is general.

The therapy of allergic diseases is well and concisely outlined and should add to the armamentarium of any physician really interested in allergy.

In general, I would say that this little volume is well done and reflects accurate records of manifold cases that would be of benefit to the general practitioner and the specialist alike.

Directory of Otolaryngologic Societies *

INTERNATIONAL

First Pan-American Congress of Oto-Rhino-Laryngology and Bronchoesophagology

President: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Secretary: Dr. Chevalier L. Jackson, 255 S. 17th St., Philadelphia 3.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Fletcher D. Woodward, 104 E. Market St., Charlottesville, Va.
Secretary: Dr. J. Milton Robb, 1553 Woodward Ave., Detroit, Mich.
Place: Chicago. Time: June 21-25, 1948.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Alan C. Woods, Johns Hopkins Hospital, Baltimore 5.
President-Elect: Dr. C. H. McCaskey, 20 N. Meridian St., Indianapolis, Ind.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 12-17, 1947.

American Broncho-Esophagological Association

President: Dr. Millard F. Arbuckle, 539 N. Grand Blvd., St. Louis.
Secretary: Dr. Paul Holinger, 700 N. Michigan Ave., Chicago 11.

American Laryngological Association

President: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis.
Secretary: Dr. Louis H. Clerf, 1530 Locust St., Philadelphia 2.
Place: Old Homestead, Va. Time: April 14-15, 1948.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Lyman G. Richards, 15 Whiting Rd., Wellesley Hills, Mass.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: Chalfonte-Haddon Hall, Atlantic City. Time: April 7-9, 1948.

SECTIONS:

Eastern.—Chairman: Dr. Robert F. Ridpath, 18th and Chestnut Sts., Philadelphia.
Place: New York. Time: Jan. 16, 1948.
Southern.—Chairman: Dr. Walter T. Hotchkiss, 541 Lincoln Rd., Miami Beach, Fla.
Place: New Orleans. Time: Jan. 23, 1948.
Middle.—Chairman: Dr. Oliver E. Van Alyea, 135 S. La Salle St., Chicago.
Place: Columbus, Ohio. Time: Jan. 19, 1948.
Western.—Chairman: Dr. Colby Hall, 1136 W. 6th St., Los Angeles, Calif.
Place: San Francisco. Time: Jan. 31-Feb. 1, 1948.

American Otological Society

President: Dr. Bernard J. McMahon, 634 N. Grand Blvd., St. Louis.
Secretary: Dr. Gordon D. Hoople, 713 E. Genesee St., Syracuse, N. Y.
Place: Old Homestead, Va. Time: April 12-13, 1948.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Alfred Schattner, 115 E. 61st St., New York.
Secretary: Dr. Norman N. Smith, 291 Whitney Ave., New Haven, Conn.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.